the TOOL and MANUFACTURING ENGINEER

APRIL 1961

tracer machining

AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS

INTERNAL GRINDING...

Are Two Wheels Better Than One?

by George H. Lockwood
Manager, Research & Development
The Heald Machine Company

Until very recently, internal grinding of a straight or taper bore has always been done with a single grinding wheel. Although this method has worked very well and will continue to be widely used, it is subject to inherent limitations under some circumstances.

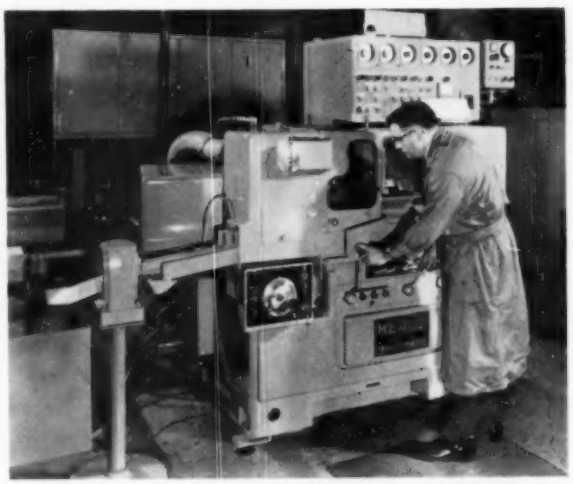
In the first place, using the same wheel for both rough and finish grinding requires a compromise in grit selection. A wheel coarse enough for maximum efficiency of stock removal in the roughing portion of the cycle may not give a sufficiently smooth surface for the finish grinding operation. So grinding speed must be weighed against surface finish, and a suitable compromise selected.

Secondly, in single-wheel grinding the wheel is usually dressed between the rough and finish portions of each grinding cycle. This increases the total cycle time by the time necessary for the dressing operation.

Both of these limitations have been removed by a unique double-wheel grinding arrangement which was first demonstrated publicly by Heald at the 1960 Machine Tool Exposition. This setup uses a single wheelhead with two separate wheels mounted on the same spindle—one for rough grinding and the other for finish grinding (see diagram below). Actual wheel specifications can be determined on the basis of maximum performance—a coarser roughing wheel for faster stock removal and a finer finishing wheel for a lower micro-inch finish. Change from rough grinding to finish grinding is simply a matter of automatically changing the position of the machine table, with no interruption of the cycle. Both wheels are dressed while the work is being loaded, hence dressing adds no time to the cycle. This represents a significant reduction in overall cycle time.

With these resultant advantages—more efficient rough and finish grinding plus no time out for dressing—a workpiece that would ordinarily require 25 to 30 seconds on a single-wheel machine, can now be ground in less than 10 seconds by the two-wheel method.

This new method is ideally suited to high production runs where maximum output is essential. But it is not the universal solution to all grinding problems. Wheel costs may run somewhat higher, since both wheels are normally dressed during each cycle and as much is removed from the finishing wheel as from the roughing wheel. An economic study of your particular requirements will show which method—one wheel or two—will yield the maximum return on your machine investment.



Heald Model 190A Centri-Matic internal grinding machine arranged for high speed double-wheel grinding of bearing races.

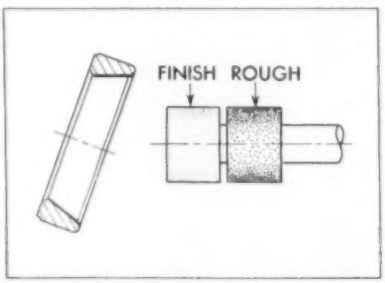


Diagram of double-wheel setup for grinding taper I.D.s of bearing outer races. The roughing wheel is mounted nearest to the wheelhead to reduce spindle deflection under heavy feeding pressure.

Your Heald engineer will be glad to tell you more about this interesting development. **It PAYS to come to Heald.**

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the TOOL and MANUFACTURING ENGINEER

Volume 46
No. 5

April
1961

The Role of Science in American Manufacturing Progress ..... *By A. B. Drought* 57

American universities have turned their attention to the scientific education of engineers. This will lead to industrial progress.

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How To Improve Tracer Lathe Accuracy—Part 1 . . *By J. Bryan, J. Bowerbank, E. Holland, O. Mohl* 64

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Paying careful attention to fundamentals is necessary to obtain top performance when using this versatile and efficient process.

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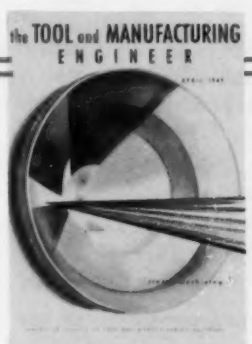
THIS MONTH'S COVER

Tracer machining techniques make it possible to duplicate the contours of a template or master to a high degree of accuracy. This accuracy can be improved by making refinements in the servo system and in the lathe itself, as pointed out in the article "How to Improve Tracer Lathe Accuracy" in this issue. In the cover drawing, the artist shows a typical tracer operation—machining a concave workpiece—in symbolic form.



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A Measure of Progress

Scientific and technical literature is being printed at the rate of 300 words per second every second of every day. That is an estimate of the International Conference on Scientific Information. One third of this, they tell us, is published in the United States. An equal volume is published, of all places, in Russia. The rest of the world accounts for the remaining third.

Three hundred words per second gains significance when it is realized to be equivalent to two million pages each month of the technical section of this magazine. It is difficult to conceive of the size of the staff that would be required to review and classify this information if an international library were set up to handle it.

We have been wont to believe we are the most progressive country on the face of the earth. Our standard of living and ability to enjoy the best things of life are second to none. We manufacture and use more domestic appliances and products than any other nation. You name it, we've got it bigger and better.

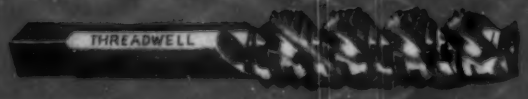
The realization that another country may equal us, even in the publication of technical literature, comes as a shock to many who have been lulled into complacency. Ability to communicate intelligent information of engineering significance is a measure of economic progress. The volume of published material is a prophecy of future trends.

Basing a conclusion so far reaching upon the relative volume of literature published may be unjustified in itself. However, those who have traveled abroad and behind the Iron Curtain report that those countries are on the move commercially. Whatever gaps exist are being closed at increasingly faster rates. This could be a benefit to mankind if intelligently appreciated on a global basis. Grant that there be the wisdom to recognize true values and temper it with understanding.

John W Greve

EDITOR

Only TURBO-CUT by Threadwell has a full 3-4 thread plug chamfer!



Benefit? Turbo-Cut's longer chamfer distributes the load over more teeth and breaks up chips to minimize tap breakage. Turbo-Cut's longer chamfer makes tapping easier and cleaner on through holes, does a one-pass job on blind holes. Only Threadwell makes the genuine Turbo-Cut with the longer chamfer.
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preview

. . . a fast look at this issue

Science and Manufacturing Engineering

As Dean of the Marquette University College of Engineering, a college that has traditionally maintained close ties with industry, A. B. Drought has followed the needs of industry for trained engineers closely. His article shows how universities are performing a dual service to industry — they educate engineers and they perform basic scientific research. This combination of teaching and research pays off in better education as well as in new knowledge, says Dean Drought. Teachers who are actively performing research are capable of generating real enthusiasm in their students. An even greater amount of basic scientific research in the manufacturing area will be needed in the future, he observes, to keep America ahead of other nations in productivity. His article starts on page 57.

Tracer Lathe Accuracy

The close tolerances that must be met by Space Age products sometimes cannot be met with existing tracer lathe and servo equipment. The answer, according to a group of engineers at the University of California's Radiation Laboratories, is to perform a series of checks on the lathe and the servo system to single out causes of inaccuracy. Once the causes are known, the proper corrective action can be taken. See the article starting on page 64.

Solution to a Mystery

All things being equal except part length, the tool life when cutting a long workpiece is shorter than when cutting a short workpiece of the same diameter. Looking for the reasons for this, A. O. Schmidt and his colleagues at Kearney & Trecker ran a series of tests. It turned out that long workpieces tend to be less rigid. Consequent chatter and vibration shorten tool life. This is particularly true when machining with ceramic cutting tools, which, despite their otherwise superior properties, are brittle and thus exceptionally sensitive to chatter and vibration. The article starts on page 69.

Ultrasonic Machining

Unable to find a definitive article on the subject of ultrasonic machining, Waldes Kohinoor tool designer Aaron Roses studied modern techniques and equipment, then wrote his own article. His advice on tool design and on applications of the process will be of particular interest to those engineers who are thinking of installing ultrasonic machining operations in their own plants and it will also be valuable to engineers who are now applying ultrasonic machining but are willing to admit that they don't have all the answers. See the article, page 71, for details.

Plant Goes Underground

By building its plant underground, Brunson Instrument Co. has obtained a controlled environment at low cost. The radiant heat from lamps used for plant illumination may ultimately be sufficient to keep the plant at a comfortable — and controlled — temperature. And, since the plant is carved out of solid rock, it is fully protected from the elements. The article starts on page 79.

Powder Metallurgy Parts

The business recession has created something of a boom in the powder metallurgy industry. Companies are looking for ways to cut manufacturing costs and production by powder metallurgy techniques is one of the answers. P. V. Schneider, IBM advisory metallurgist, has long experience in powder metallurgy techniques and he shares that experience with readers of this magazine in a comprehensive, yet concisely written, article, page 81.

Productivity '61

Productivity '61 — the ASTME annual Manufacturing Engineering Conference and Tool Exposition — takes place in New York City, May 22 through 26. Full details are given in the Productivity Program in this issue, page 97.

LOW-SLUNG AND POWERFUL, *the VerciPower offers unusual flexibility for toolroom and production milling. It is available in twelve sizes: 20 to 50 hp, 34" to 72" table travel. Catalog No. M-2130.*

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Senator Vance Hartke of Indiana has introduced a bill to give American industry more favorable depreciation allowances. Senator Hartke has pointed out that about one-third of the tools and machines used by American industry are old-fashioned, outmoded and inefficient.

It would take about $100 billion to replace the machinery and equipment than managers believe is obsolete, according to Senator Hartke. This amount, equivalent to one-third of the National Debt, increases by $5 to $6 billion every year.

Obsolescence of productive equipment, says the Senator, is primarily the result of a continuous, and continuing failure to permit industry to deduct from taxable income an amount sufficient to maintain existing machinery and to replace it when it becomes uneconomical to operate.

The bill (S. 720) provides a deduction for depreciation measured by the cost of the reinvestment necessary to maintain the size of the taxpayer's investment. The deduction is limited to the number of dollars actually reinvested; hence plant modernization is encouraged.

✓ ✓ ✓

Foreign manufacturers are enjoying much more favorable depreciation allowances than manufacturers in this country. And, according to T. Laurence Strimple, president of Cleveland's National Acme Co., many overseas countries are undergoing a crash program to improve the quantity and quality of their products in order to compete more vigorously with U. S. industry.

Foreign maufacturers continue to buy high-speed, precision machines in this country. Strimple says that export sales accounted for a substantial share of his company's 31.6 percent increase in sales during 1960. National Acme makes automatic bar and chucking machines, threading tools, electrical controls and shell molding equipment.

✓ ✓ ✓

Looking at another side of the picture, Lawrence M. Weitzel, president of Mechanical Specialties Co., Los Angeles, quotes French industrial importers as saying that lack of uniformity in the quality and performance of American machine tools, as well as their high cost, are deterrents to the expansion of U.S. machine tool exports. Weitzel recently served as machinery specialist with the U. S. Department of Commerce trade mission to France.

✓ ✓ ✓

Comments by R. M. Sills, General Electric application engineer, are indicative of the technological progress abroad. Sills, who recently visited Russia, told of Russian progress in automation at a recent AISI meeting. "All indications are," he said, "that the USSR has placed its economic future in the hands of the automation and systems engineers. This extreme concentration is expected to raise product quality and productivity of the individual worker to levels surpassing that of the Western World."

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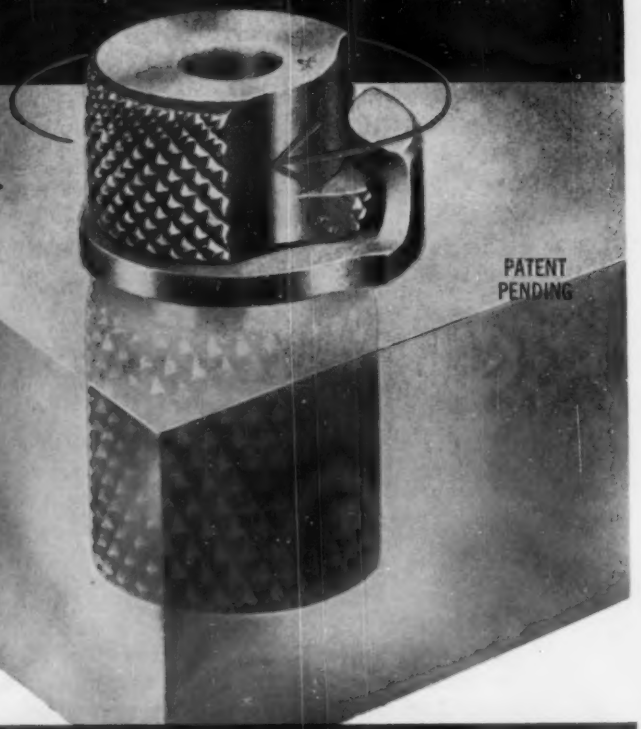

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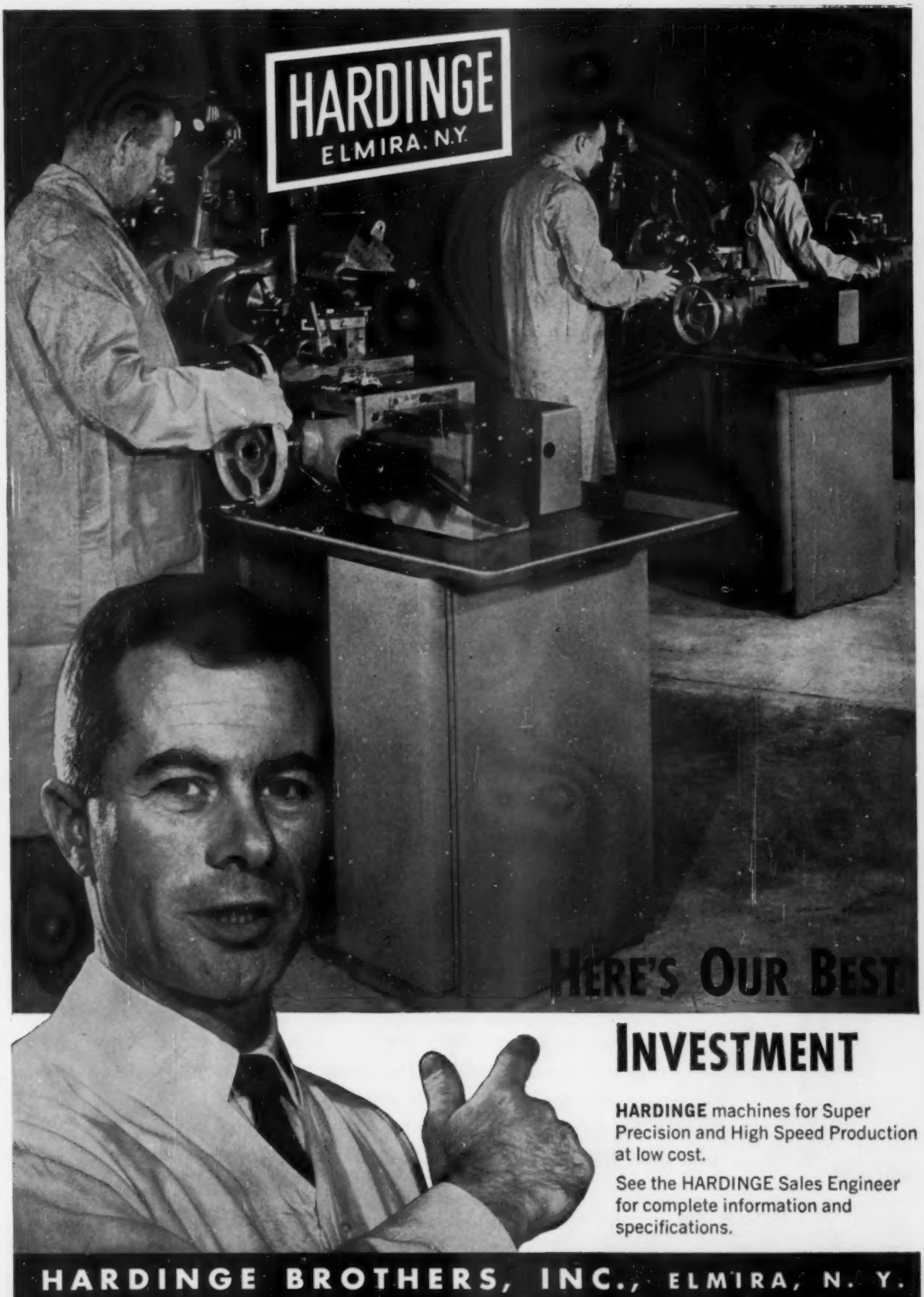
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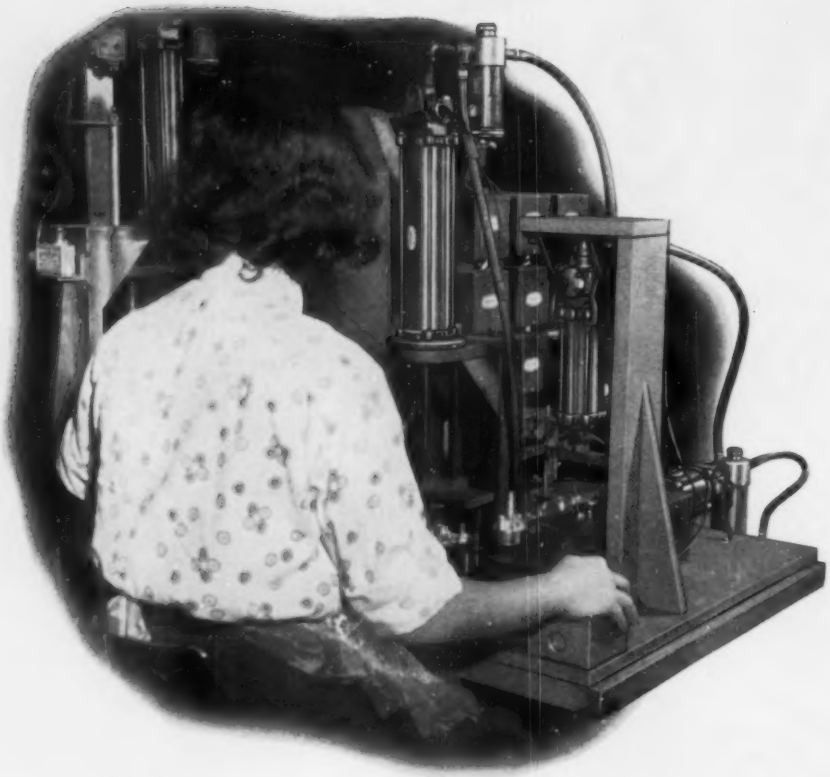

But secondary operations can be a big untapped profit source

A case in point: At Kalamazoo Die Casting, a second operation of deburring three critical points in a phonograph pickup arm took three operators (two women and a man) one hour to deburr 350 parts. An ingenious methods man at the plant designed the unit shown above. It is built around three Bellows Air Motors®, a Bellows Air Vise and Bellows control units. Now one girl handles the three deburring operations at a rate of 425 parts per hour.

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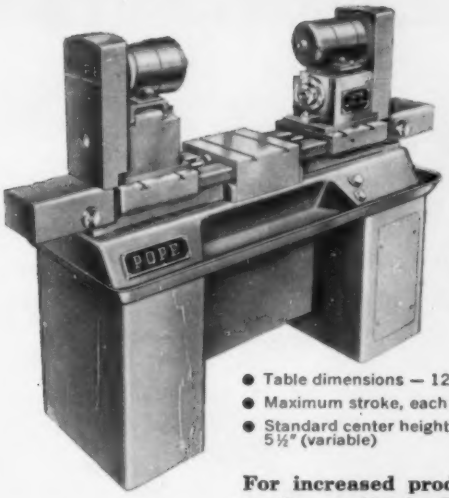

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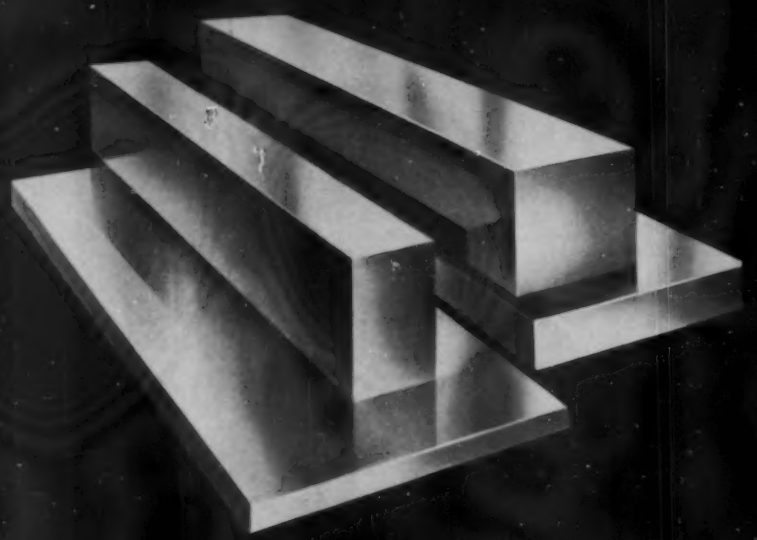

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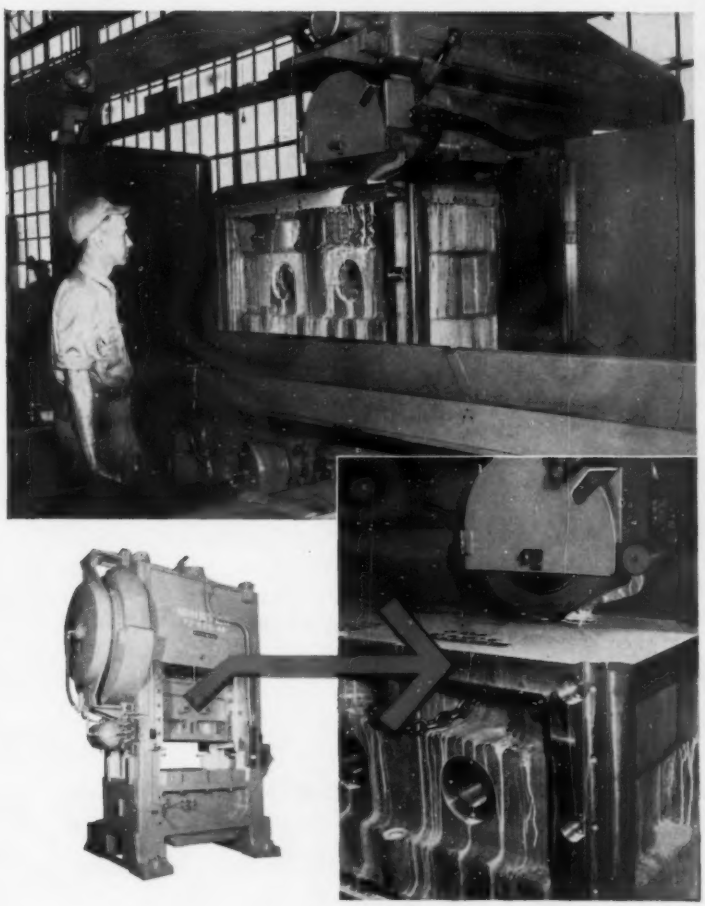

Thompson Type CX heavy-duty surface grinders are designed to grind heavy, massive work pieces. Their stock removal rate is very fast while maintaining extremely close limits of accuracy and microfinish.

Shown here is a Thompson Type CX 30x36x96 machine recently installed in the Minster Machine Company plant at Minster, Ohio. It is grinding the face of the slide for a 200-ton capacity Minster Piece-Maker High Speed Automatic Production press.

The slide is cast iron and weighs approximately 7000 pounds. It is being ground for precise parallelism and to a 20 to 30 RMS finish.

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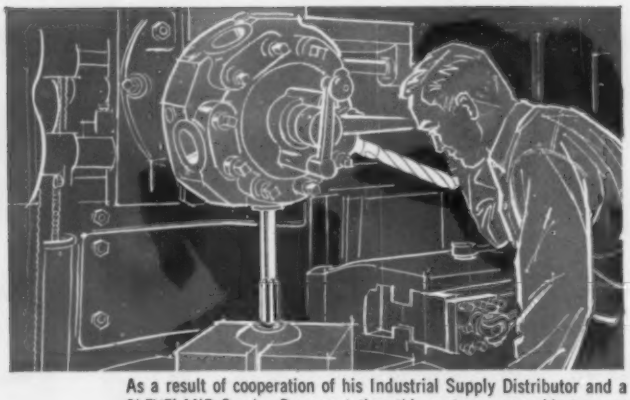
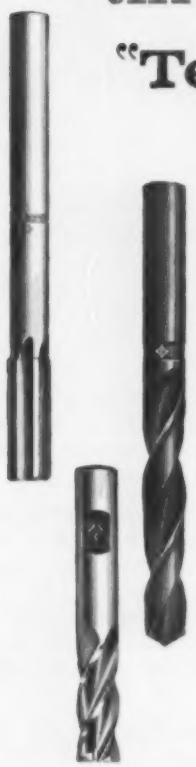


As a result of cooperation of his Industrial Supply Distributor and a CLEVELAND Service Representative, this customer was able to ream 1,800 holes per grind in a 1040 steel projectile part, without sacrifice of hole size or finish. A typical example of "Teamwork Tooling"!

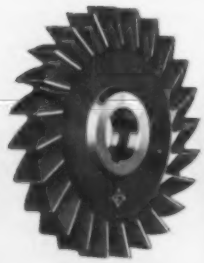


When you tackle the problem of cost reduction, you will find the solution is not *cost per tool*, but rather *cost per hole*.

And, if you apply Value Analysis to the subject of cost per hole, you always arrive at the same answer: Only with *quality* tools can you get faster production, less down-time and fewer rejects.

When you buy CLEVELAND Tools you get the very best manufacturing experience and know-how . . . *plus* the added benefits of "Teamwork Tooling", which means combining the skills of many people to help you reduce costs.

CLEVELAND Quality Tools can be obtained from the stocks of your local Industrial Supply Distributor, who has the assistance of our trained Service Representatives to recommend savings through proper tooling for *your* job conditions.



THE CLEVELAND TWIST DRILL CO.
Cleveland 1, Ohio

QUALITY CUTTING TOOLS • BEST SERVICE THROUGH YOUR LOCAL DISTRIBUTOR

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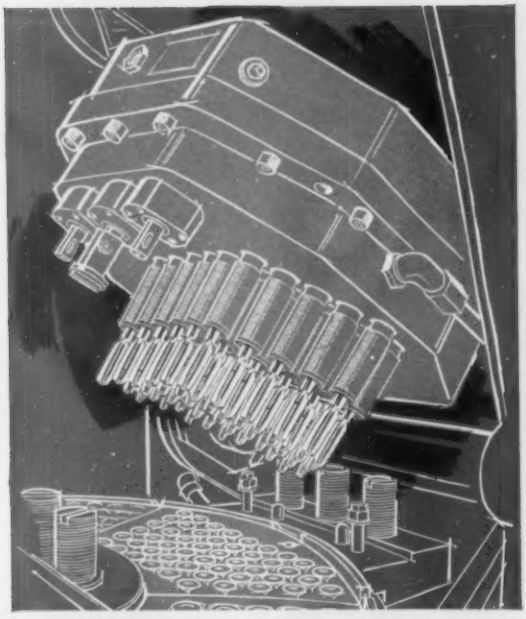
To Help You Cut Your Tapping Costs



BAY STATE Taps have the strength and stamina to reduce costly down-time on this high speed set-up, where 25,000 holes are threaded per hour. The taps have built-in QUALITY . . . your assurance of cost reduction on all jobs, whether large or small.

The most economical tapping operations can be performed only with *highest quality* taps.

You can reduce your costs with BAY STATE *Quality* Taps. These tools are designed, engineered and manufactured for precision performance . . . to give you long, dependable service which is your assurance of maximum production with a minimum of costly down-time.

BAY STATE *Quality* Taps and Dies are carried in stock for prompt delivery by your local Industrial Supply Distributor, who maintains balanced inventories for you at lowest cost. Moreover, the steady flow of orders from hundreds of distributors enables us to produce the tools in large, economical quantities—with resultant advantages to you.

BAY STATE TAP AND DIE CO.
Mansfield, Mass.

Subsidiary of The Cleveland Twist Drill Co.

QUALITY CUTTING TOOLS • BEST SERVICE THROUGH YOUR LOCAL DISTRIBUTOR

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Announcing
CARMET®

700

Series Cutting Grades

to boost production–extend tool life up to 200%

If you're tooling-up for a really tough cut, try Carmet's new 700 Series Cutting Grades. Make one super-duty tool do the work of two or three—on any steelcutting job, including superalloys.

Carmet's 700 Series is a new, premium group of carbide grades just released after exhaustive field trials. Results were conclusive. These carbides stood up under the roughest interrupted cuts going. They gave longer tool life than competitive grades in the same application class. And, they produced exceptionally fine finish cuts, even in C-8 precision boring classifications.

Here are the 700 Series Steelcutting Grades, and their applications:

CA-704 Hard and dense for the ultimate in finish cuts and precision boring.

CA-711 Ideal for medium to finish cuts in the general purpose category.

CA-720 Tough and thermal shock-resistant for medium and heavy cuts, including interrupted cuts.

These new Carmet Grades combine edge wear and crater resistance with an unmatched ability to endure shock. The 700 Series will outperform other groups of tools in any C-5 to C-8 application. Take a look at a few customer trial reports:

"Turning tapered, slotted, forged SAE 4140 valve plugs . . . formerly got 8 finished pieces per cutting edge. Now get up to 25 pieces with CA-720 on a tough, interrupted cut!"

"Turning OD of universal joint ears . . . now getting 177 pieces with CA-720 against 135 with former tool."

"On SAE 1035 rotor shafts . . . got 7 more shafts per tool with CA-711. And K Monel shafts . . . got more from 9 CA-711 tool corners than 12 corners on triangular inserts formerly used."

"On SAE 4320 forgings . . . a whopping 242 pieces with CA-720, against 209 with previous Carmet 600 Grade, 198 with best competing tool."

Remember, for less demanding operations, the 600 Series Cutting Tools will continue to be sold by Carmet. But for the really tough cut . . . when you've got to make chips on a mean, tool-buster of a job . . . this kind of performance from the 700 Series will save you time. And, cost you less than competing premium grades!

They're doing just that in shops all over the country . . . right now! Try them, just once, on your job. Your local Carmet Distributor has them in stock. Contact him for more information, or write: ***Carmet Division, Allegheny Ludlum Steel Corporation, Ferndale, Detroit 20, Michigan. Dept. TE 4-1.***

CARMET 700 SERIES CATALOG SUPPLEMENT NOW AVAILABLE

There's a new Supplement to the Carmet Catalog C-16-B, listing tool and insert styles, and prices for the new 700 Series. Contact your local distributor, or write Carmet direct.

2890

CARMET® AL

CEMENTED CARBIDE - DIVISION OF ALLEGHENY LUDLUM

INDUSTRY'S **FIFTH COLUMN**

Tunnel vision! Restricted outlook! Tunnel vision acts as a fifth column in America's war for economic survival. It causes **management** to see only the balance sheet and ignore the pressing need to retool. It causes **labor** to picture only pay hikes without compensating productivity. It causes **government** to kill, with unrealistic depreciation allowances, the goose that lays its golden tax eggs. Tunnel vision distorts American industry. Let's open our eyes. It's later than we think.

A machine tool is only as good as the CUTTING TOOL it drives. The industrialist who "economizes" on a cutting tool defrauds himself—not only of machining accuracy but of the increased production and resulting profits which can be delivered. Pratt & Whitney Cutting Tools will bring out the best in your machine tools, will help win **your** battle for economic survival.

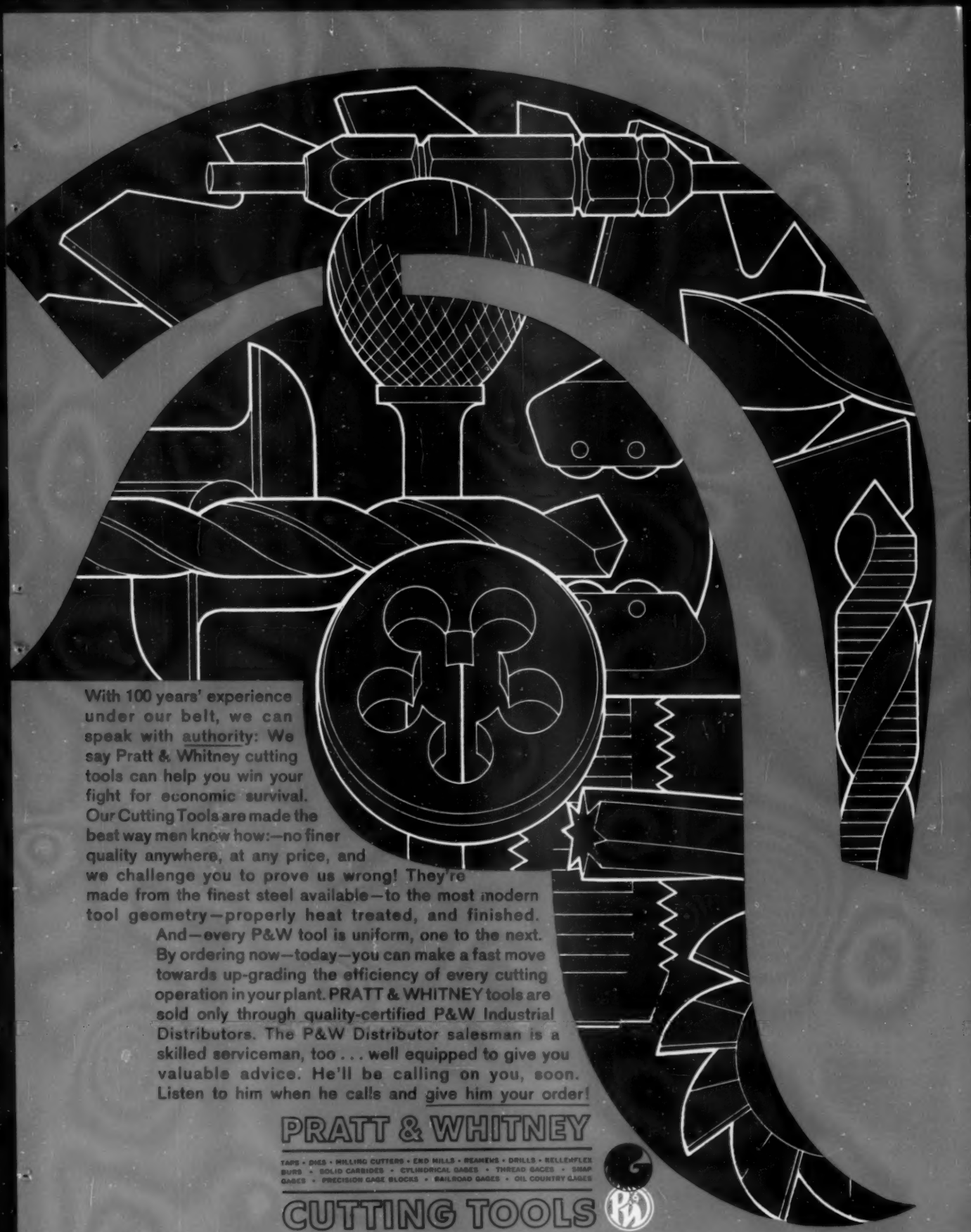
Pratt & Whitney

HEADQUARTERS FOR AMERICA'S WAR AGAINST OBSOLESCENCE

machine tools / cutting tools / gages

A MAJOR INDUSTRIAL COMPONENT OF **FAIRBANKS WHITNEY CORPORATION**

WANTED NOW!
CUSTOMERS WHO WANT TO WIN
THE FIGHT FOR SURVIVAL



With 100 years' experience under our belt, we can speak with authority: We say Pratt & Whitney cutting tools can help you win your fight for economic survival. Our Cutting Tools are made the best way men know how:—no finer quality anywhere, at any price, and we challenge you to prove us wrong! They're made from the finest steel available—to the most modern tool geometry—properly heat treated, and finished.

And—every P&W tool is uniform, one to the next. By ordering now—today—you can make a fast move towards up-grading the efficiency of every cutting operation in your plant. PRATT & WHITNEY tools are sold only through quality-certified P&W Industrial Distributors. The P&W Distributor salesman is a skilled serviceman, too . . . well equipped to give you valuable advice. He'll be calling on you, soon. Listen to him when he calls and give him your order!

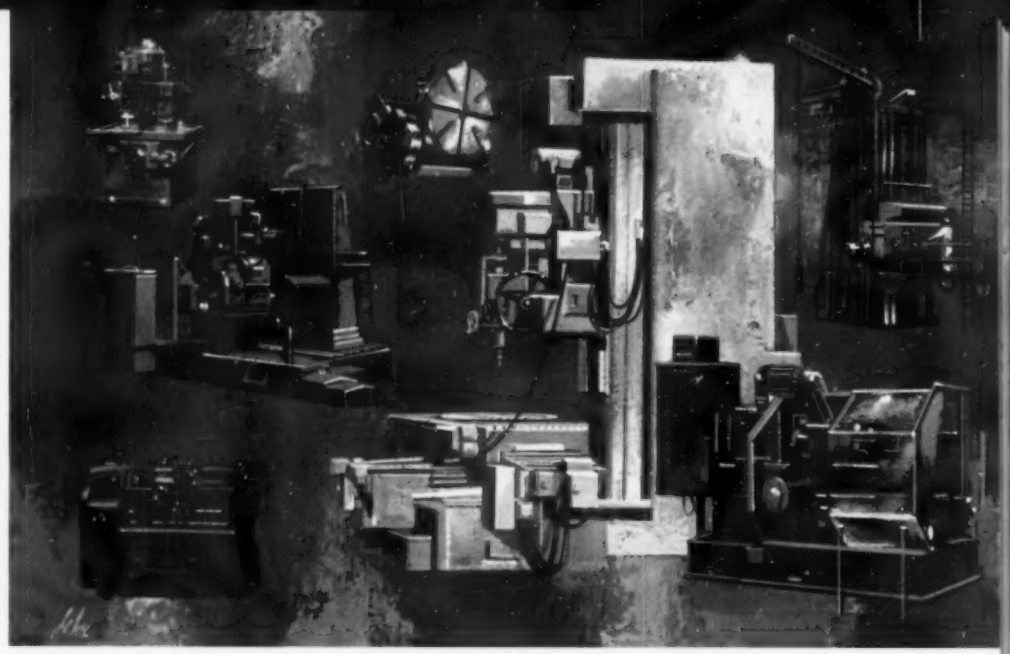
PRATT & WHITNEY

TAPS • DIES • MILLING CUTTERS • END MILLS • REAMERS • DRILLS • KELLEMFLEX BURS • SOLID CARBIDES • CYLINDRICAL GAGES • THREAD GAGES • SNAP GAGES • PRECISION GAGE BLOCKS • RAILROAD GAGES • OIL COUNTRY GAGES

CUTTING TOOLS

P&W MACHINE TOOLS

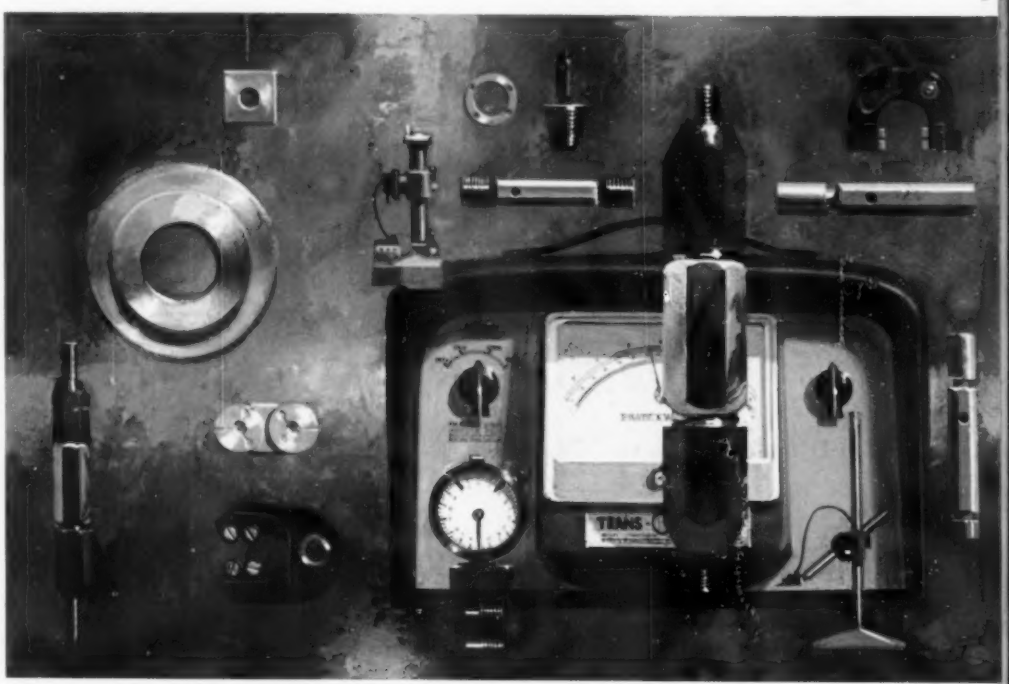
Are you producing prototypes, dies, large or small lots of production parts? Ultra-precision locating (to "tenths" accuracy)? Boring, profile milling (with or without masters)? All these and countless other problems can be solved with P&W machine tools at production line speed, efficiency and economy. Machines such as the world-famous P&W KELLER,® P&W JIG BORER, P&W ROTARY TABLE and P&W POTTER & JOHNSON AUTOMATIC TURRET LATHE are available with manual or numerical controls in a variety of models to fit your needs. P&W can also supply the MAGNETRACE PROFILER, SIM LATHE, INNOCENTI-MITSUBISHI MILL and the DIAFORM WHEEL FORMING ATTACHMENT...high grade performers all. For more information ask your P&W representative.



IN YOUR FIGHT TO **SURVIVE** YOU NEED THE FINEST WEAPONS

P&W GAGES

More than ever, production efficiency depends on fast, precise, economical gaging. P&W supplies all types of gaging equipment. Thus, you can choose those that do your job at lowest cost... from simple CONVENTIONAL GAGES to the most intricate tape-controlled INSTRUMENT GAGES. Types include PLUG, RING, THREAD and SNAP GAGES, INTERNAL and EXTERNAL COMPARATORS, and PRECISION GAGE BLOCKS... all available through selected Industrial Distributors. The exclusive series of AIR-O-LIMIT,® TRANS-O-LIMIT® and DATA-LIMIT® gages and famous "FLYING MIKE" CONTINUOUS GAGE are available from your P&W representative. Bring your gaging problems to him.



MACHINE TOOLS – CUTTING TOOLS – GAGES • HEADQUARTERS FOR AMERICA'S WAR AGAINST OBSOLESCENCE

PRATT & WHITNEY

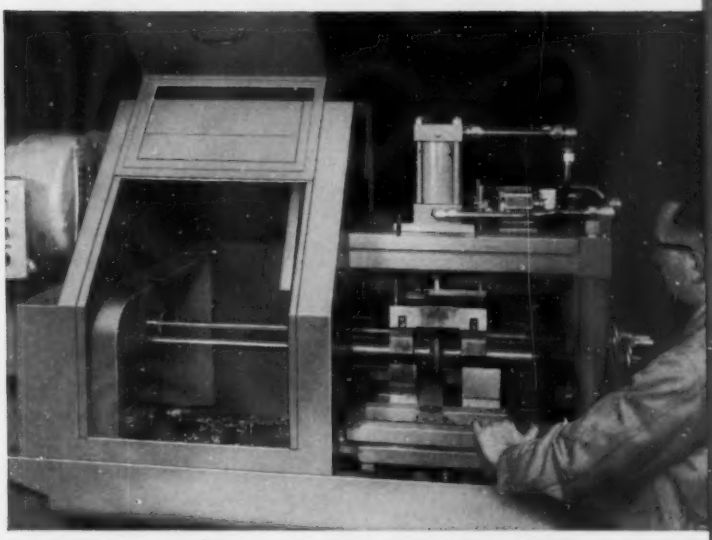
A MAJOR INDUSTRIAL COMPONENT OF

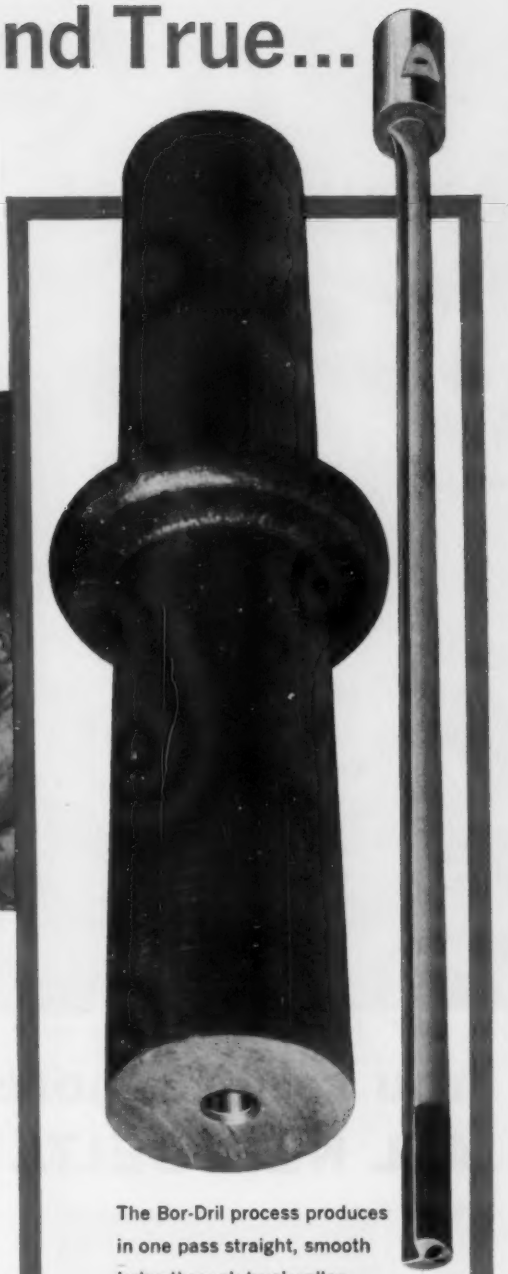
FAIRBANKS WHITNEY

PRATT & WHITNEY COMPANY, INCORPORATED, CHARTER OAK BOULEVARD, WEST HARTFORD, CONNECTICUT

Deep Holes...Fast and True... with Ex-Cell-O

BOR-DRIL





The Bor-Dril process produces in one pass straight, smooth holes through track roller shafts 22½" long and weighing about 75 pounds each. Production is 20 pieces per hour on the two-station machine.

Drilling 11/16" diameter holes the full length of 22½"-long forgings posed a tough problem for production engineers who need the economy of volume output, the time-savings of one-step operations, and the performance of precision equipment. But they found the answer in Bor-Dril, Ex-Cell-O's process for gun-type drilling with standard production boring machines.

Measured in terms of production efficiency, the result is 20 pieces per hour, from an Ex-Cell-O Model 752 Precision Boring Machine set up for Bor-Drilling. Secondary operations are eliminated.

Bor-Dril can be applied easily and economically wherever you have long, small-diameter holes to produce to precision tolerances. See your Ex-Cell-O Representative, or submit your requirements direct to Ex-Cell-O for prompt analysis and cost estimate.

60-30

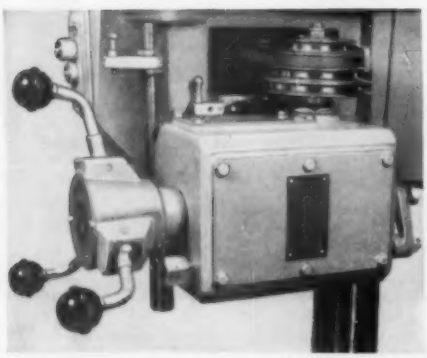
EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TOROBE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

You can do more with these ALL NEW DELTA 17″ drill presses



Equipped with exclusive new Rockwell Power Feed, these presses can operate in remote control or be interlocked with automation devices. Available as original equipment or as an accessory on every model.

FREE BROCHURE—Complete specifications on the new Delta 17" drill presses and accessories. Write: Rockwell Manufacturing Co., Delta Power Tool Division, 620D N. Lexington Ave., Pittsburgh 8, Pa.

Here's a major engineering advance from Delta to give you increased drilling accuracy, more job flexibility and greater operating economy. You can choose from 76 models that incorporate these up-to-date performance features: New Internal Depth Stop Mechanism, Quick-set Depth Gage, Interference-free Guard and Pivot-type Motor Mount.

These drill presses are completely new—not merely improved or restyled—but actually redesigned to deliver consistent precision operation under the most rugged work loads with little or no maintenance.

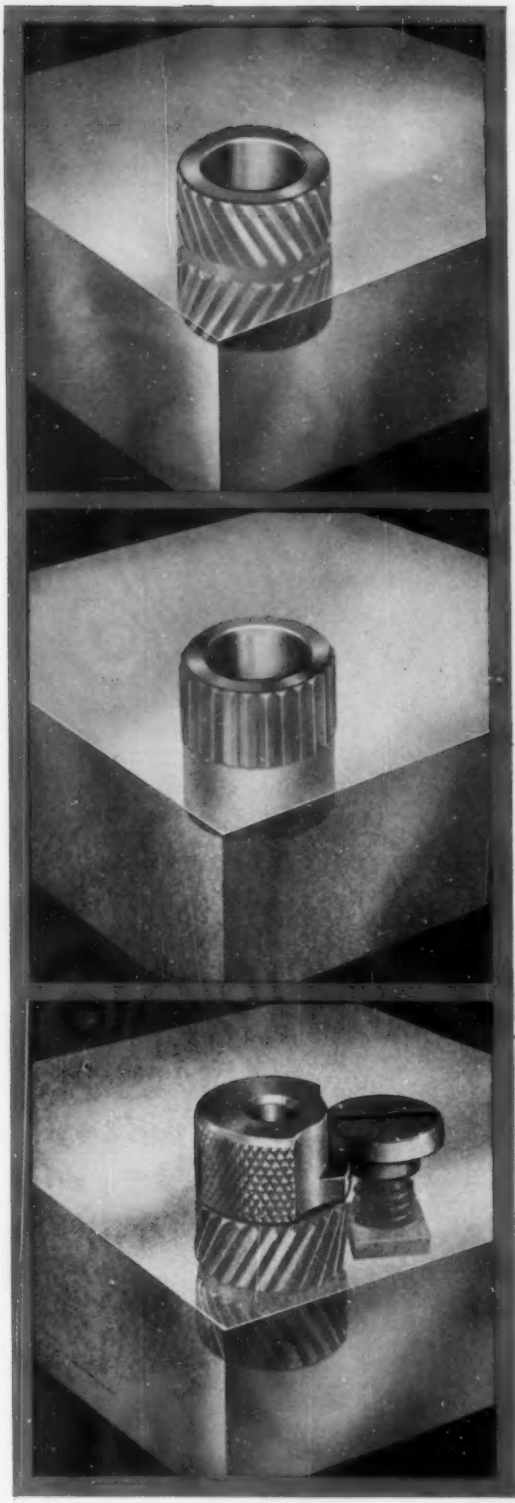
Your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages) will gladly demonstrate how these 17's can save you dollars, hours and material. Why not call or see him soon!

DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL

Use Reader Service Card, CIRCLE 22



NOW in STOCK for Immediate Delivery...

Ex-Cell-O Drill Jig Bushings for All Plastic Tooling Jobs!

FOR 'POTTING'...

Ex-Cell-O Trans-Lok Bushings have exclusive herringbone knurl and annular groove design for maximum security in potted-type jigs, fixtures and templets. Bushings can't twist or pull out.

FOR PRESSING...

Ex-Cell-O Press-Lok Bushings have straight knurls for greater gripping power when pressed into plastic, wood or other ductile materials.

FOR RENEWABLE BUSHINGS, TOO...

Ex-Cell-O Trans-Lok Liners, with the same deep transverse ridges as Trans-Lok Bushings, permit drilling or reaming using standard fixed-renewable or slip-renewable bushings.

Made of high chrome, high carbon oil-hardening bearing steel, Ex-Cell-O Bushings for plastics have uniform hardness, 62-64 Rockwell C precision ground diameters, and conform to A.S.A. standards and Ex-Cell-O's own high standards for quality.

Send today for catalogs covering Ex-Cell-O's complete line of bushings for plastics and metal or order direct from stocks in Detroit or Downey, Cal.

60-70

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS CASES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Precision Parts Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

NEW MODEL 1220 DYNAPAK

RUGGED POWERFUL EFFICIENT

DYNAPAK MODEL 1220 . . . massive, rugged all-new model of industry's only proven *high energy rate forming* machine! All-new Dynapak saves expensive metal chips — eliminates costly machining.

SAVES METAL
SAVES MACHINING
SAVES TIME

DYNAPAK MODEL 1220 is designed and built to work a full day *every* day . . . efficiently, dependably, economically! Dynapak uses only one-quarter of its available energy to exceed the force of a 6,000-ton press—always has power in reserve. Models with operating capabilities up to 8 strokes per minute are available.

DYNAPAK MODEL 1220 is versatile—makes a wide variety of products ranging from production tooling to complex turbine blades, missile nose cones and tiny precision surgical pins. Tool steel and the exotic "problem" metals become everyday materials to Dynapak's unique capabilities.

DYNAPAK MODEL 1220 can help *you* do a better job of forging, forming, compacting. Dynapak can help you cut costs and improve profits. Find out now about dependable, performance-proven Dynapak — the new concept in *high energy rate forming*. Write, wire or phone for complete information.

GENERAL DYNAMICS CORPORATION / ADVANCED PRODUCTS DEPARTMENT

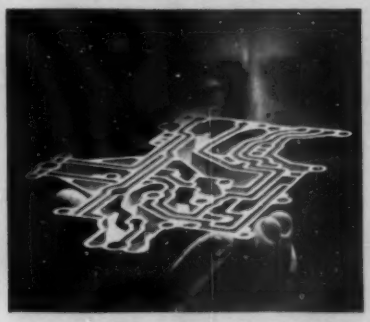
GD

P.O. Box 6231 • San Diego 6, California

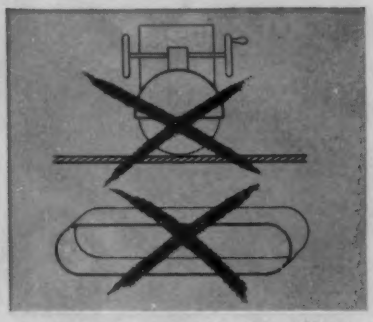
Aluminum Problems?

See how the LAPMASTER can lick 'em...

CLAMPING ELIMINATED. Aluminum, magnesium and all non-ferrous metals can't take clamping without warp or distortion. The Lapmaster eliminates this serious problem because flat surfaces are lapped in a free, unclamped state. Flatness checks show that the Lapmaster *consistently* produces surfaces to extremely close tolerances... even irregularly shaped parts, like those above, pass the most rigid inspection for flatness.



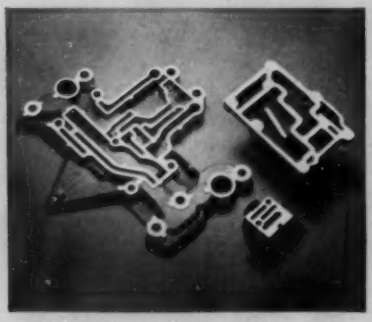
"AS-CAST" WARPAGE REMOVED FAST. Lapmasters quickly rectify "as-cast" warpage on flat surfaces of non-ferrous metal parts. Lapping produces the true, flat reference plane desired for subsequent machining. In other instances where parts become distorted due to clamping and chucking operations, a short, follow-up cycle on a Lapmaster will return the surfaces to their original flat condition.



GRINDING PROBLEMS VANISH. There is no such thing as "lap plate loading". If you've tried grinding or belt sanding aluminum or magnesium, you know how fast the wheels load... how difficult and costly it is to prevent surface gouging, ripping or tearing. But with the Lapmaster method of stock removal, you never face such problems. Instead, you get uniform accuracy and a scratch-free finish, piece-after-piece.

NO MORE BURRS. After lapping on a Lapmaster, burrs just don't exist. Finger testing proves it every time. Lapping eliminates the expense of subsequent hand deburring operations and helps reduce inspection costs. This advantage is especially important in the finishing of pump, compressor or engine parts or on parts incorporating "O" ring groove on the face.

FAST STOCK REMOVAL. Lapping of non-ferrous metals on a Lapmaster is a finishing method that saves time and money for hundreds of manufacturers. Stock removal rates are high. Other methods requiring expensive tooling still cannot match the accuracy of lapping. And Lapmasters do it right the first time, every time.



PERFECTLY MATED SURFACES. In many cases, Lapmasters eliminate difficult gasketing problems by lapping mating surfaces to microinch finishes of 2 to 3 AA, to flatness within one light band (.0000116") or less and parallelity of exacting tolerances. The Lapmaster, for example, produces mating surfaces on aluminum transmission parts that will hold oil at 200 psi. Its uniform accuracy also eliminates selective assembly.

Lapmaster®

...THE MACHINE THAT PUT PRECISION LAPPING ON A PRODUCTION BASIS

Write for the complete Lapmaster catalog of facts and money-saving ideas.

A product of

Crane Packing Company

6469 OAKTON STREET • MORTON GROVE, ILLINOIS (Chicago Suburb)

In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

In England: Payne Products International, Slough Bucks.

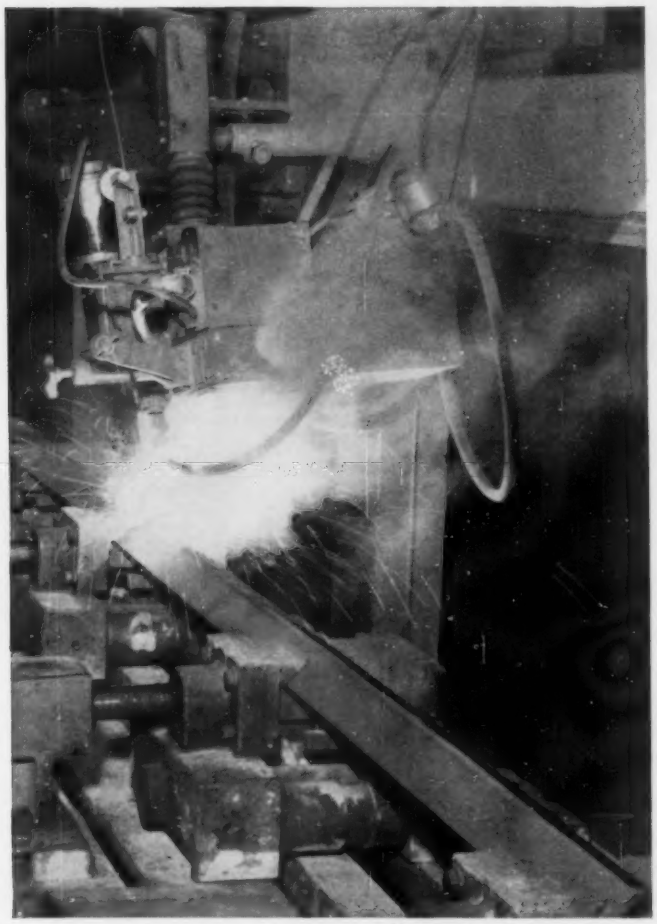
Leading automaker saves because . . .

INNERSHIELD ELIMINATES

Two Innershield heads moving horizontally with two moving elliptically weld brackets to rear axle in 4½ seconds. No separate flux or gas systems needed.

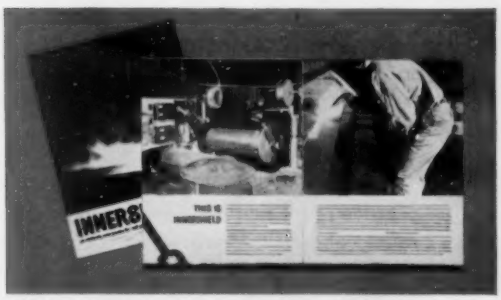
COSTLY FLUX HANDLING

Lincoln's new Innershield process is clean. No need for expensive flux handling and recovery systems. No abrasive dust to wear out costly, complex fixtures. Atmosphere stays cleaner, simplifies housekeeping, improves working conditions. No slag removal problems.



Innershield's special tubular electrode contains all ingredients for welding—fluxes, deoxidizers, filler metal. No Argon or CO_2 needed. Here, Innershield welds angle iron for farm machinery part at 80 ipm compared to 40 ipm with CO_2. Tanks, hoppers, structural beams all are now welded with this process, too.

Semi-automatic Innershield Squirt lets an amateur turn pro in minutes. Electrodes bridge gaps caused by poor fitup. Slag flicks off with a swipe of the electrode tip. Have a Lincoln field engineer show you how Innershield Squirt can increase the operating factor and deposition rates on your jobs.

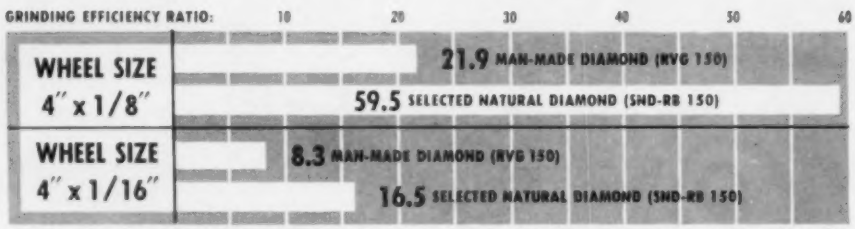


New brochure describing Innershield process and full and semi-automatic equipment is just off the press. Get your copy now. Write The Lincoln Electric Company, Dept. 3021, Cleveland 17, Ohio.

LINCOLN WELDERS

THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT AND ELECTRODES

Tests prove... SND (Selected Natural Diamond) doubles cup wheel life and output in carbide tool grinding



TEST CONDITIONS—Dry Grinding • WHEELS: Cup Type-D6A9 • SPINDLE SPEED: 3600 RPM. (3800 S.F.M.) • DOWNFEED: .0015" • MATERIAL: ½" x ¾"

One wheel with SND (Selected Natural Diamond) does the work of two wheels containing man-made diamond in carbide tool grinding!

The unequalled performance capabilities of SND —the most advanced development of diamond technology—are now proven indisputably in *realistic* tests with cup wheels, conducted under shop-use conditions that apply in your own tool grinding operations.

Performance results, charted here, provide positive proof that SND assures unmatched efficiency and economy in precision grinding procedures. As shown, SND outperforms man-made diamond with up to *98% greater grinding efficiency in 1/16" rim cup wheels*... with up to *172% greater efficiency in 1/8" rim cup wheels!*

To the diamond wheel user, this means that SND doubles or triples wheel life and output over man-made diamond cup wheels... insuring wheel cost savings of at least 50%!

Your diamond wheel supplier has the knowledge and experience to help you select SND (Selected Natural Diamond) in wheels best suited to your particular requirements.

To keep up to date on latest developments in industrial diamond technology—including indisputable test results that prove SND superiority—write for Engelhard Hanovia's technical bulletins.

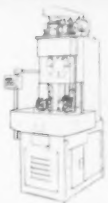
★ ★ ★ ★ ★ ★ ★ ★

★ENGELHARD HANOVIA, INC.★
INDUSTRIAL DIAMOND DIVISION
113 ASTOR STREET · NEWARK 2, NEW JERSEY

Use Reader Service Card, CIRCLE 28

Use Reader Service Card, CIRCLE 29

Exclusive New Britain design
for greater boring accuracy



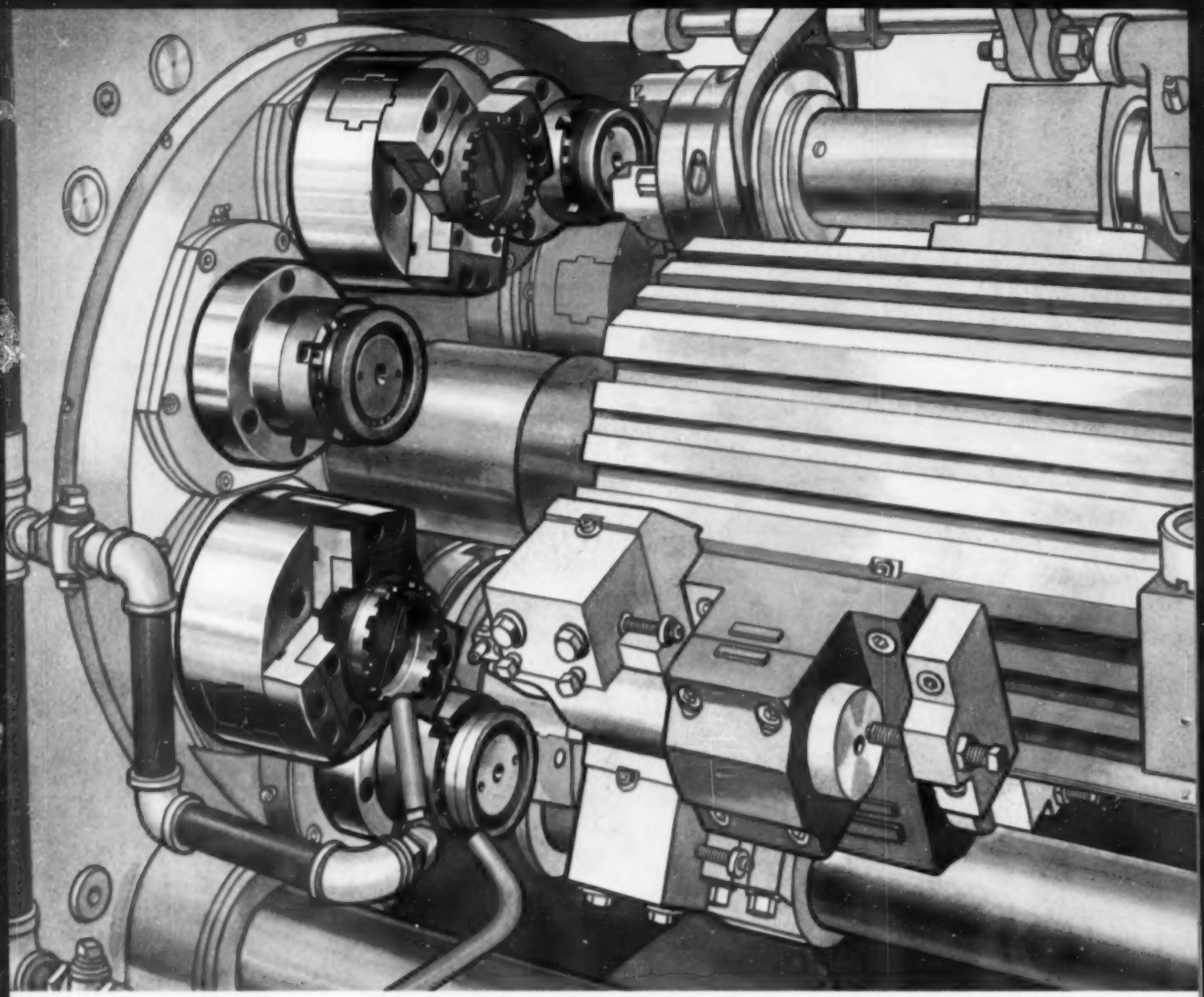
This is the vertical slide of one of the new series New Britain Vertical Contour Turning and Boring Machines with the front plate removed exposing the cams. These cams are mounted on a common shaft which rides with the vertical slide controlling its motion as well as the motion of the cross slide. Containing all slide actuating forces in the vertical slide is an exclusive New Britain feature which represents a major development in boring machine design.

No outside forces are imposed on the slide ways. Extreme accuracy and rigidity are achieved permitting heavy cuts. Finish cuts of less than .0003 tolerance can be made on the same set-up.

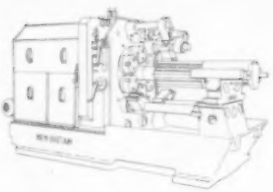
The elimination of long actuating linkages has allowed for the design of a compact, clean sided, simplified machine. Cams are quickly accessible and easy to change.

The major improvement which the cam-in-head principle makes on the already widely accepted superiority of cam control results in high repetitive accuracy regardless of the complexity of the piece. Building-block applications, using more than one machine side by side, allow all kinds of possibilities for increased production efficiency.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division ◆ New Britain, Connecticut



Double indexing... differential chucking pressures *with New Britains*



Here are two features that go a long way toward indicating how much and what kind of work you can do on New Britain's Chuckers. The double indexing feature is a really workable approach to the production of two identical pieces per cycle or both sides of a piece. This application can frequently eliminate the need for second-operation machines. Chucking pressures can be adjusted so that as the machine progresses through the cycle, and more and more metal is removed, the piece will not be distorted.

These are only two of a dozen different New Britain Chucking Machine features. These rugged, powerful machines are your best bet for high production turning, forming, facing, threading, tapping and related operations. New Britain's complete line of chuckers includes four-, six- and eight-spindle models, with work swing up to 17 inches. Wide open design in all models allows for the quickest possible disposition of chips.

Make a point of calling in your New Britain representative soon. Let him show you the dollars and cents reasons for including New Britains in your replacement or expansion plans.

THE NEW BRITAIN MACHINE COMPANY

New Britain-Gridley Machine Division ◆ New Britain, Connecticut

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Another report on Air-4 tool steel

Blanking and embossing this automotive part, from coiled steel of .125 in. thickness and doing it at substantial speed, is all in a day's work for Bethlehem Air-4 tool steel . . . at Melrath Metal Stamping Corp., Red Hill, Pa. Tool engineers at this plant have several good reasons for giving a good report on Air-4: they like the ease with which it can be machined . . . its simple heat-treatment, and above all, they admire its wear-resistance. Hardened to Rockwell C-60, the die undergoes slight redressing every 100,000 strokes of the press.

HARDENS AT LOW TEMPERATURE

Air-4 is a free-machining, medium-alloy tool steel which hardens in air—at about 1550 F. It has excellent free-machining characteristics because of a lead addition. It also has excellent wear-resistance and high toughness, and is deep-hardening to assure long tool life.

Air-4 is a versatile tool steel. Why not place an order right now for a trial bar, and use it in an experimental run? Your Bethlehem tool steel distributor can give you prompt delivery.

Bethlehem Tool Steel Engineer Says:

Always Heat-Treat the Tool Instead of the Thermocouple

Many tool failures can be attributed to the use of improper temperatures during heat-treatment. In many instances, although the thermocouple chart may have indicated proper heat-treatment temperatures, the microstructure of the tool shows that the recorded temperatures were not attained by the tool. This is called "heat-treating the thermocouple, instead of the tool."

It is easy to see why such errors occur, for the thermocouple indicates the temperature at the location of its tip only. Most furnaces have some non-uniformity of temperature. For example, locations near the source of heat are hotter than remote locations. And the bottom tends to be colder than the top. An operator who is on the ball will survey his furnaces to determine what temperature differences are present. This will assist him in selecting the location which will provide the most accurate indication of the temperature of tools heated in each furnace. It will often indicate that more than one thermocouple is needed.

Where a temperature survey is not feasible, the tip of the thermocouple should be placed as near the tools as possible. But avoid locations near the floor, sides, roof, or near the source of heat. Although the thermocouple is accurate, and highly useful, it's by no means foolproof.

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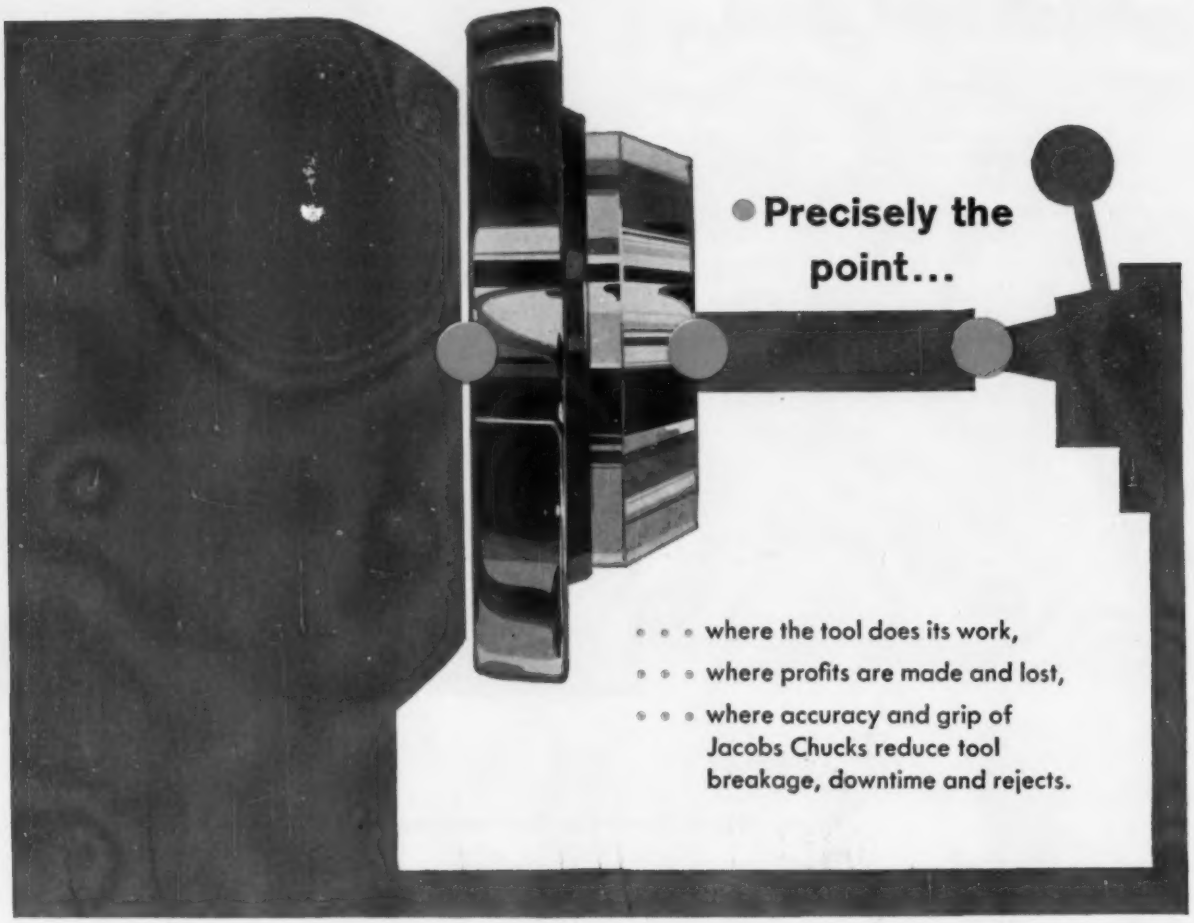
Use Reader Service Card, CIRCLE 31

When you buy new tools or four factors come first

ACCURACY GRIP


Precisely the point...
where the tool does its work,
where profits are made and lost,
where accuracy and grip of Jacobs Chucks reduce tool breakage, downtime and rejects.

The Jacobs Model 50 is the world's most modern collet chuck. Model 50 and its entirely new series of Jacobs Rubber-Flex collets have been developed especially for Atlas, Clausing, Delta, Logan, Sheldon, South Bend and similar lathes. With Model 50 on your lathe you get a lot more for less.

ACCURACY is greater with Model 50 because collet jaws are always parallel and maximum run-out is .001″ T. I. R. at the nose, when properly mounted.

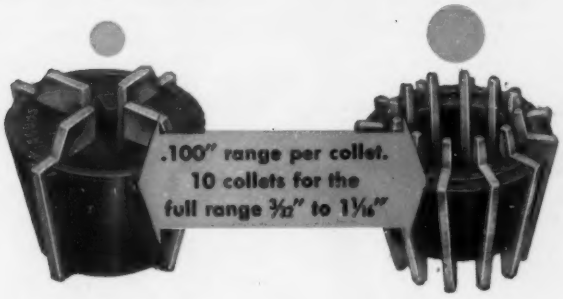
GRIP is greater because the extra long collet jaws have tremendous torque capacity.

modernize your old ones at the chucking end

RANGE PRICE

COMPLETE SET OF 10 RUBBER-FLEX COLLETS CHUCK ANY BAR BETWEEN 3/32" and 1 1/16"

RANGE is greater because the 10 Rubber-Flex collets in this new series cover a greater bar stock range than **63 old-fashioned split steel collets . . .** .100" range per collet.



PRICE **is revolutionary!**

$70.00 Model 50 Collet Chuck

$65.00 Complete set of 10 Rubber-Flex Collets

This performance at these prices proves the point. You can't afford not to modernize your lathes with Jacobs Model 50 and Rubber-Flex collets.

See your Jacobs industrial supply distributor. Give him the opportunity to prove the facts with a demonstration at your desk! Call him today. If you'd like further details before you call, write Jacobs, Department 196 at the address below.

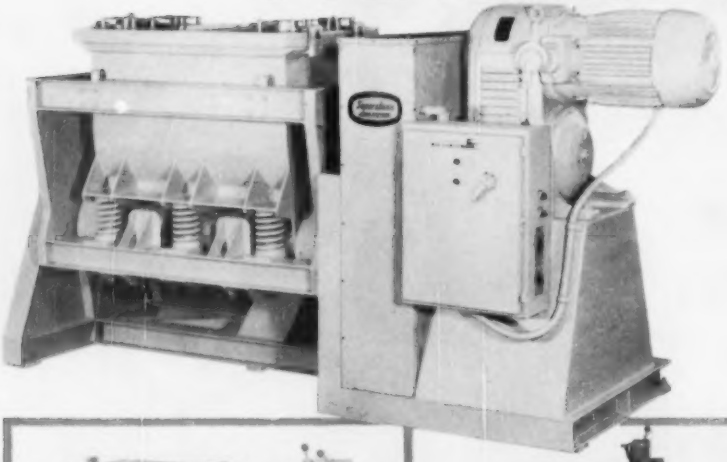
Jacobs CHUCKS

THE JACOBS MANUFACTURING COMPANY,
WEST HARTFORD, CONNECTICUT

UP TO 100 TIMES FASTER FINISHING WITH

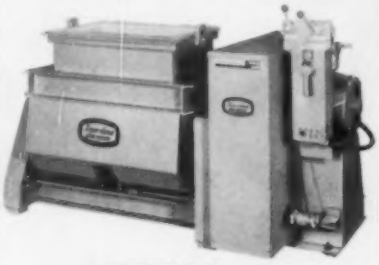
ALMCO

VIBRASHEEN



ALMCO'S FULL LINE OF NEW VIBRASHEEN MACHINES

MODELS VT-717 — 712
(18 and 12 cu. ft. capacities)
Ideal for large components requiring fixtures or a large volume of smaller parts.



MODELS VT-77 — 75
(7 and 5 cu. ft. capacities)
Efficiently deburrs and finishes parts in quantities suitable for medium size production runs.

MODELS VT-72 — 71
(2½ and 1 cu. ft. capacities)
Popular unit for firms requiring precise finishing of a wide variety of parts in small lots.

MODEL VT-70
(¾ cu. ft. capacity)
Bench model ideally suited for miniature bearings, extremely small gears, stampings, etc.

WORLD'S LARGEST LINE OF PRECISION FINISHING EQUIPMENT

ADVANCED DESIGN SERIES
Thirteen models are available in this series featuring capacities of from 5 to 40 cu. ft., each equipped with variable speed drives. (Infinite from 6 to 30 rpm's.)

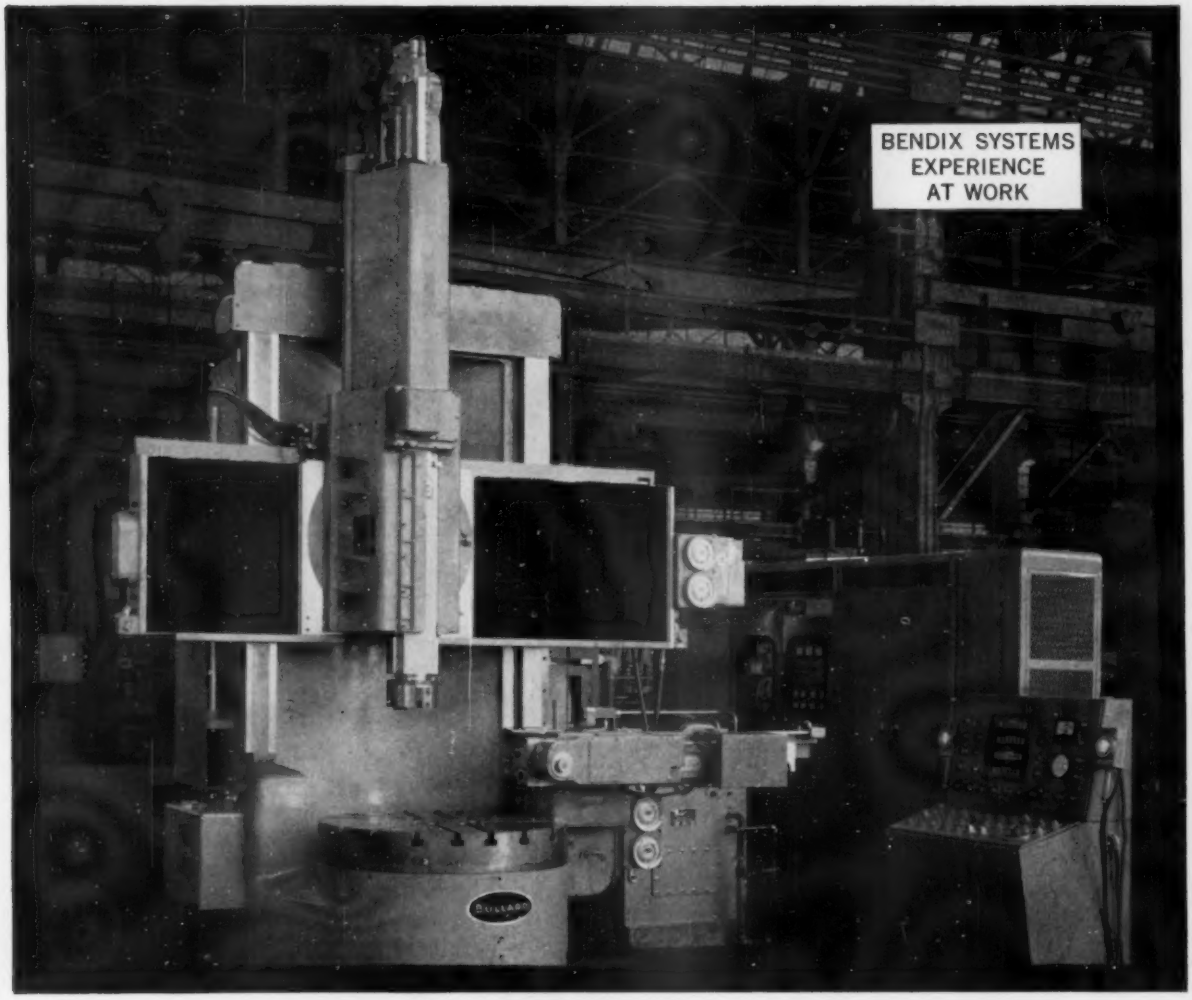
SPINDLE MACHINES
Designed for fast precision finishing of complex, high quality components such as gears, bearing cages, spline shafts, rotors, on continuous production "in line" basis.

CUSTOM DESIGN BARRELS
Special large diameter barrels are available to accommodate extra large parts. Fixtures hold parts to assure complete, precise finishing of all crevices and surfaces.

SEND FOR NEW ALMCO CATALOGS ON BARREL FINISHING MACHINES MEDIA, AND COMPOUNDS

ALMCO Supersheen

Queen Products Division Of King-Seeley Thermos Co.
1804 Marshall Street • Albert Lea, Minn.



BENDIX SYSTEM ENGINEERING PROVIDES OPTIMUM NUMERICAL CONTROL FOR TURRET LATHE

Shown above is a Bullard four-axis vertical turret lathe equipped with Bendix DynaPath-14 contouring control unit. In this application, the selection of tools and spindle speeds is programmed, as is the motion of both slides.

Bendix application engineers, with accumulated experience in mechanical and hydraulic analysis of machine tools, worked closely with Bullard to produce this wedding of machine tool and numerical controls. And Bendix systems experience gained in working on other contour turning applications (with such companies as Ex-Cell-O, Heald, and Giddings & Lewis) assures the user correct application of control unit to machine tool.

In addition to contour turning applications, Bendix engineers numerical control systems for milling, grinding, drilling and jig boring machines. We have developed and applied controls to 2-, 3-, 4-, and 5-axis systems, both continuous path and point-to-point. These controls are being used daily in plants across the country to increase machine tool efficiency, reduce lead times, and make parts of consistently high accuracy.

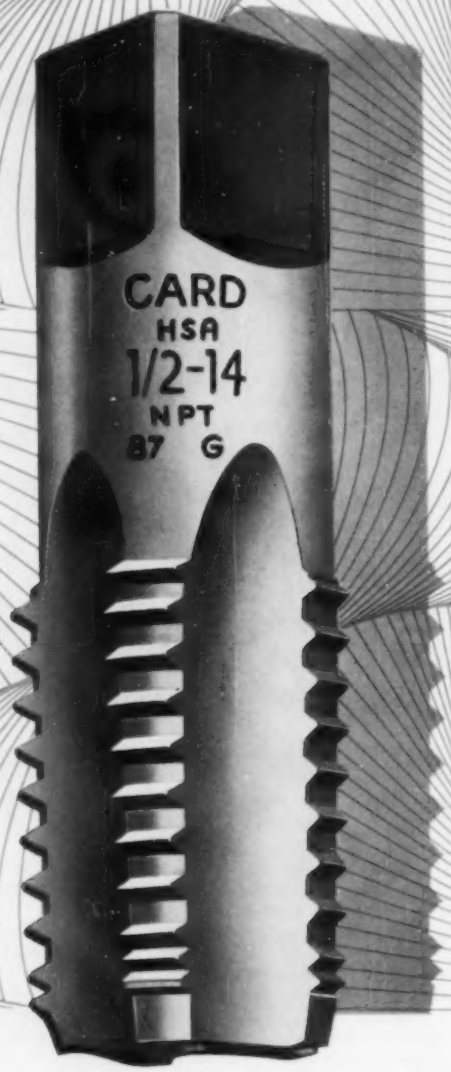
Bendix SYSTEMS EXPERIENCE can provide the key to your machine tool problems. The right Bendix numerical control unit can be the profit-maker you've been looking for. Start putting Bendix application engineering experience to work for *you*—write today for a copy of our catalog number 308.

BENDIX PROVIDES SYSTEMS EXPERIENCE

JUSTIFICATION STUDIES • SYSTEM ENGINEERING • TRAINING AND SERVICE

Industrial Controls Section

21820 Wyoming Ave., Detroit 37, Michigan



TAPS
DIES
GAGES
SCREW PLATES

GEOMETRIC PROGRESSION symbolizes the precise duplication you need in cutting tools. CARD makes sure you get this production advantage in actual form ... through expert engineering that reproduces CARD tools exactly, plus helpful service from your CARD distributor and the CARD technical man, who are quickly available in the nation-wide CARD network. S. W. CARD DIVISION, Union Twist Drill Company, Mansfield, Mass. CARD Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

CARD

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GEOMETRIC PROGRESSION SYMBOLIZES PRECISE DUPLICATION.

DRILLS
REAMERS
MILLING CUTTERS
END MILLS
GEAR CUTTERS
HOBS
CARBIDE TOOLS
INSERTED BLADE CUTTERS

UTD

FOLLOWING A PATTERN of geometric progression, UNION cutting tools of the same type and size are exactly duplicated... in quality, dimensions and precision performance. They are calculated to cut costs ... your costs ... in the widest range of cutting tool operations. UNION distributors and technical service are available nationally. Fully stocked UNION warehouses in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco. UNION TWIST DRILL COMPANY, Athol, Mass. S. W. Card Div., Mansfield, Mass. Butterfield Division, Derby Line, Vermont.

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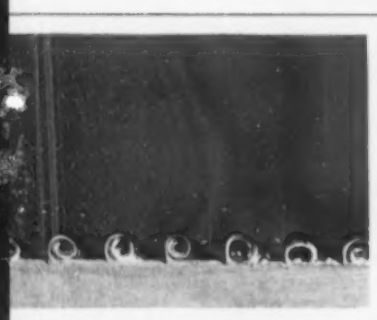
"Ups" your cut-off capacity . . .
SIMONDS "RED END" Hacksaw Blades



Simonds tough, edge-holding "Red End" Blades don't hack at metal, but cut curled chips like the cutting tool on a lathe. Made to rigid, high quality standards, they have greater resistance to breakage . . . step up your cut-off capacity.

Longer wearing, too, Simonds own unique cross-rolled steel and special heat treatment add many valuable hours of cutting life to every blade . . . provide important savings all along the line.

Simonds "Red End" Power Blades come in All-Hard and Shatter-proof types in all standard lengths, thicknesses and tooth spacings. Three types of Hand Blades are available in all standard specifications . . . insure a "right" blade for every need.

Get off-the-shelf delivery from your local Simonds Distributor . . . start saving today.

SIMONDS
SAW AND STEEL CO.
FITCHBURG, MASSACHUSETTS

Buy through your local Simonds Distributor for — Local Stocks – Local Speed – Local Skill

Factory Branches in Union, N. J., Chicago, Shreveport, La., Los Angeles, San Francisco, Portland, Ore. • Canadian Factory in Granby, Que. • Simonds Divisions: Simonds Steel Mill, Lockport, N.Y.; Heller Tool Co., Newcomerstown, Ohio; Simonds Abrasive Co., Philadelphia, Pa. and Arvida, Que., Can.

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WHITMAN & BARNES
MAKERS OF FINE TOOLS SINCE 1845
DRILLS AND REAMERS

which drill really costs less?

Based on results, drills "A" and "B" (center and right, above) should cost 43% and 39% less than W & B drills (left, above)—instead, they can be purchased at *only* about 20% less.

Watch those *initial* costs—they may be *costly!*

W&B

PARTNERS IN PRODUCTION PROGRESS

COMPARATIVE DRILLING PERFORMANCE

General Purpose Jobbers Drills	*No. of holes per drill size					Total No. of Holes	Efficiency Rating
	#40	#30	3/16"	1/4"	5/16"		
W & B Drills	208	62	57	50	34	411	100%
"A" Drills	142	24	14	28	28	236	57%
"B" Drills	114	49	13	61	15	252	61%
Thickness of plate	9/32"	3/8"	1/2"	1"	1"	Material: Heat treated chrome nickel steel	

**In each drill size, five drills of each brand were tested and each drill was resharpened three times as required.*

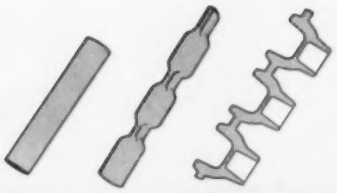
Many drill performance tests similar to this one have been made. However, W & B will gladly conduct drill tests at *your* plant and under *your* conditions. Contact us direct or through your W & B distributor. He can offer this service plus fast delivery from complete stocks.

WHITMAN & BARNES

40000 PLYMOUTH ROAD • PLYMOUTH, MICHIGAN

DRILLS • REAMERS • END MILLS • COUNTERBORES • COUNTERSINKS • CARBIDE TOOLS • SPECIAL TOOLS

REDUCEROLL + MAXIPRES = Modern Forging!

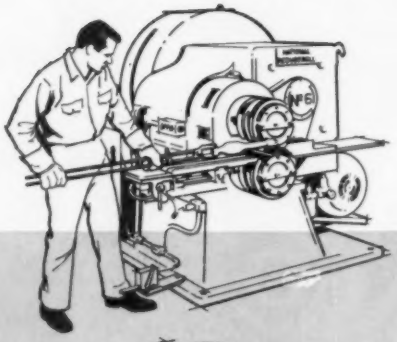


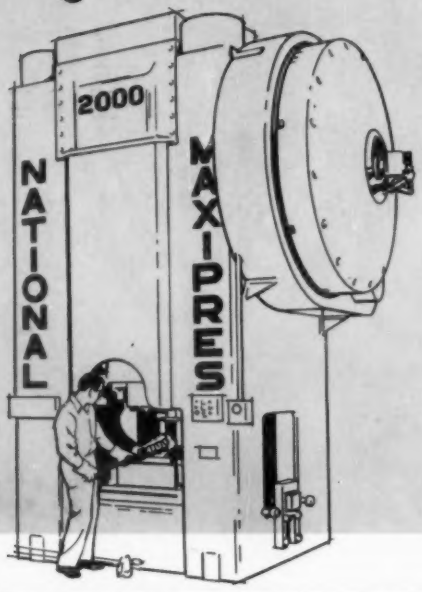
Modern forge plants around the world are using the method shown at right:

1. Prepare forging blanks in Reducerolls;
2. Finish forge in Maxipresses on the same heat.

Cost of making these forgings, and others, reduces by *one third* (even more!) thanks to modern engineering, latest-design equipment and proven methods.

Bring your prints or forgings to Tiffin. Let's discuss your plans for automatic or manual forging, but without obligation.





Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

HARTFORD **DETROIT** **CHICAGO**

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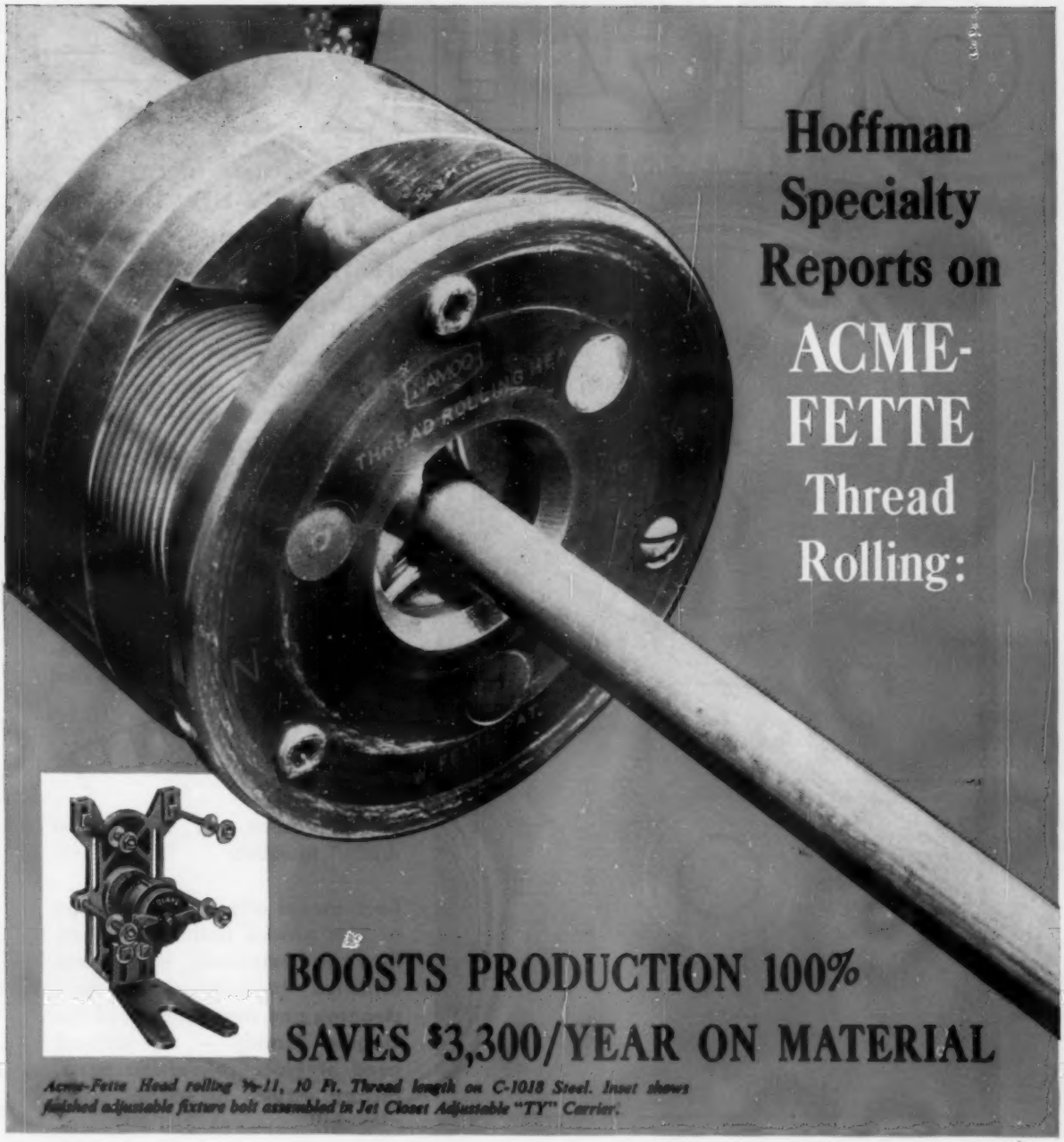

Acme-Fette Head rolling ⅝-11, 10 Ft. Thread length on C-1018 Steel. Inset shows finished adjustable fixture bolt assembled in Jet Closet Adjustable "TY" Carrier.

"Doubled production . . . saved us $3,300 on material alone . . . rolled over sixteen *miles* of thread with same set of rolls . . . produced stronger, more easily-assembled threads with finer finishes . . ." This is the Blake Division of Hoffman Specialty Manufacturing Corporation describing a year's operation with an Acme-Fette N-3 Self-Opening Thread Rolling Head. Such superior performance is easily explained: Because the Acme-Fette Head generates the thread progressively from the front of the rolls, metal flows to the thread's full depth eliminating broken grain structure and cratering at the thread crest. The result is a thread with a high grade burnished surface, remarkably resistant to wear and corrosion. And, Acme-Fette Heads roll any parallel or tapered thread from 1/16" to 2" up to *5 times faster* than thread cutting tools. Get full details. Send for Bulletin NAF-57A.

ROLLED THREADS ARE BEST...ACME-FETTE'S BEST FOR ROLLING

National Acme

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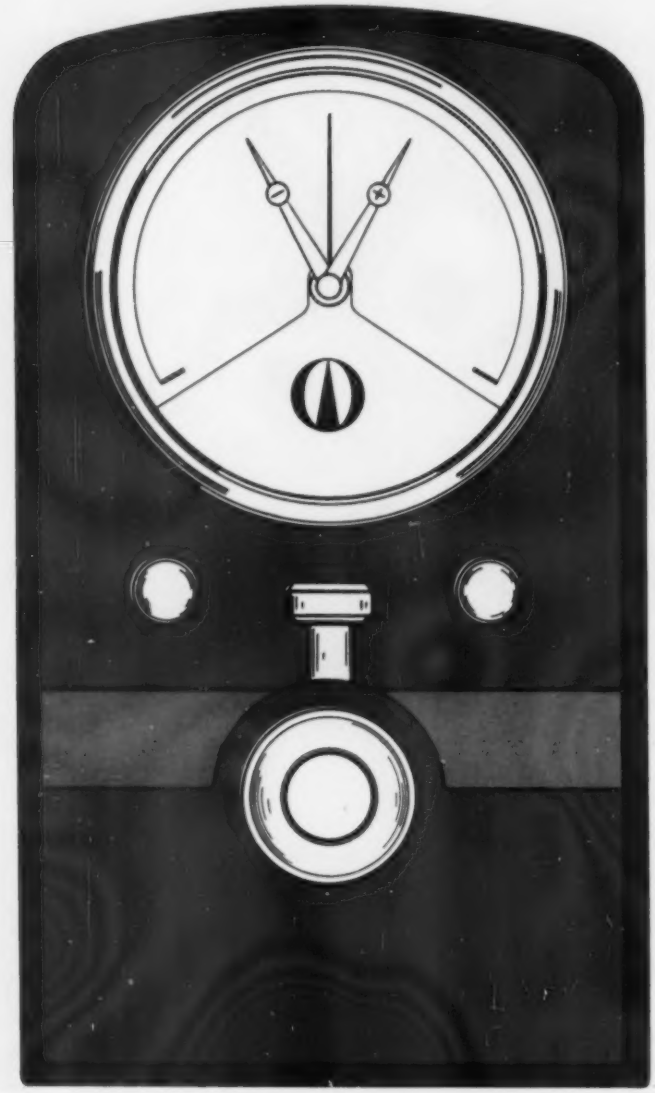
193 E. 131st STREET
CLEVELAND 8, OHIO

Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

ON ZERO—



STANDARD'S NEW LINE OF AIR GAGES — FEATURES ADJUSTABLE MAGNIFICATION

With Model #120, recommended for all normal inspection tolerances, this portion of the dial

can represent any value from .0005" to .060" and, with Model #240, recommended for extremely precise inspection tolerances, this same portion of the dial

can represent any value from .0001" to .0005".

Each model offers a wide range of dial values and zero points; plus an extremely quick and effective "blow-down" for easy cleaning and maintenance of the Gaging Stands — all without need of tools, conversion parts, factory service or special operator skill.

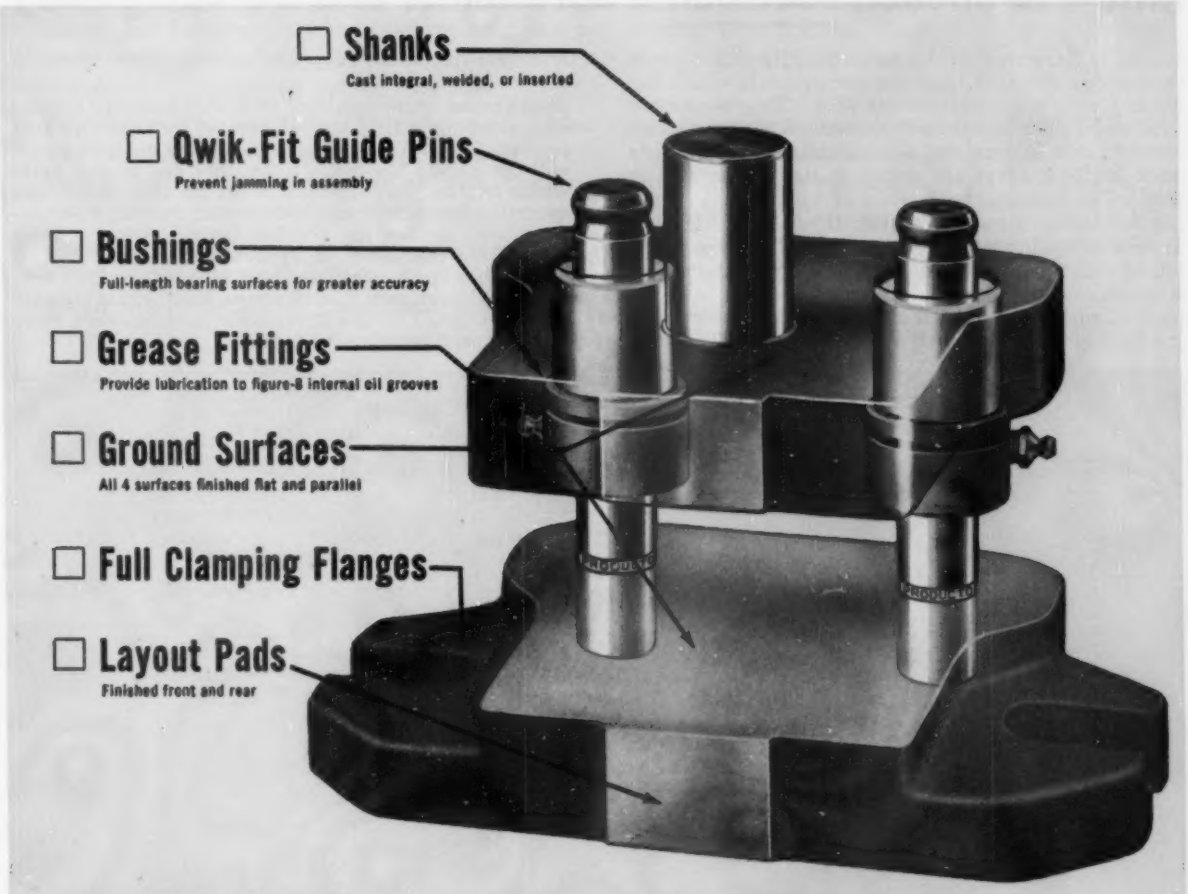
Among many economical advantages to the user is the fact that conventional air plugs and air rings, even from most other manufacturers, last longer and can do a greater variety of inspection jobs when used with STANDARD Air Gaging Stands.

For complete catalog and price list, or on-the-job demonstration in your own plant, write or phone your nearest representative or contact:

STANDARD GAGE COMPANY, INC.

POUGHKEEPSIE, N. Y. **TELEPHONE GROVER 1-3100**

☐ Check the benefits you get in a Producto Die Set...


☐ Shanks
Cast integral, welded, or inserted
☐ Qwik-Fit Guide Pins
Prevent jamming in assembly
☐ Bushings
Full-length bearing surfaces for greater accuracy
☐ Grease Fittings
Provide lubrication to figure-8 internal oil grooves
☐ Ground Surfaces
All 4 surfaces finished flat and parallel
☐ Full Clamping Flanges
☐ Layout Pads
Finished front and rear

Annealed Steel Sets—All-steel catalog die set components are fully annealed before machining

Guide Pins—5-8 micro inch finish on all Master and Commercial guide pins for ideal wear and lubrication qualities

Many styles of Master (Precision) and Commercial shoulder bushings, all available in press-fit or removable types

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New products, new ideas!

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PRODUCE MORE WITH PRODUCTO PRECISION DIE SETS

HANDY ALLOY DATA SHEET

HANDY & HARMAN ENGINEERING DEPARTMENT
82 FULTON STREET, NEW YORK 38, N.Y.

TEC and TEC-Z

...How to choose between a soft solder and a brazing alloy

Handy & Harman provides *two* alloys that fit between "something stronger than the average soft solder but not as strong as a silver-brazing alloy." They are named TEC and TEC-Z and their flow points are intermediate between soft solders and silver-brazing alloys. Joints made by these alloys are strong in straight tension or shear. For instance, butt joints of cold-worked copper can be made having a tensile strength of about 25,000 psi. This is approximately 10,000 psi. more than can be obtained with tin-lead soft solders. TEC joints retain their strength at elevated temperatures much better than the tin-lead soft solders. As shown in the table below, the strength of the solder itself at 425° F is about the same as a 50% tin–50% lead solder at room temperature in short-time tensile tests.

Applications—One example is a thermostatic bellows where the operating temperature is too high for soft solders (tin-lead), yet requires a joining medium which will not anneal the bellows. Another use is gun parts which require joint strength at higher than soft-solder operating temperatures *plus* corrosion resistance to solutions used in cleaning and blackening. Also for lamp bulb bases operating at approximately 350°-500° F. Automotive applications and heat exchangers. TEC conforms to Government Specifications Mil-S-19234 (Nord); both TEC and TEC-Z are available in sheet, wire, powder, and preforms to specifications.

NOMINAL COMPOSITIONS

	TEC	TEC-Z
Silver	5% plus or minus 0.5%	5% plus or minus 0.5%
Zinc		16.6% plus or minus 0.5%
Cadmium	95% plus or minus 0.5%	78.4% plus or minus 0.5%

PHYSICAL PROPERTIES

	TEC	TEC-Z
Color	White	White
Melting Point	640° F	480° F
Flow Point	740° F	600° F
Density (Troy oz/cu in.)	4.60	4.53
Electrical Conductivity (Cu=100)	22.0%	20.6%
Electrical Resistivity (Microhm-cm)	7.9	8.4

STRENGTH COMPARISON TEC vs. Pb-SN

	TENSILE STRENGTH LBS/SQ IN. TEC	TENSILE STRENGTH LBS/SQ IN. Pb-SN
ROOM	16,400	2,500
300° F	4,400	650
425° F	2,600	Melts
500° F	1,700	

The information and data on this page are available in our Handy Alloy Data Sheet. Ask for "TEC." Handy & Harman, 850 Third Ave., New York 22, N. Y.

Your No. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

General Offices: 850 Third Ave., New York 22, N. Y.

Offices and Plants: Bridgeport, Conn. • Chicago, Ill. • Cleveland, Ohio • Dallas, Texas • Detroit, Mich. • Los Angeles, Calif. • New York, N.Y. Providence, R. I., • Montreal, Canada • Toronto, Canada

DISTRIBUTORS IN PRINCIPAL CITIES

Used in the plants of

CATERPILLAR TRACTOR CO.

LAPOINTE BROACHING MACHINES

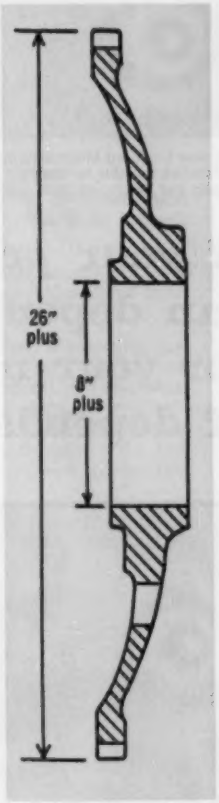
rate an "assist" in making our highways safe!

The big Cat 631 Tractor-Scraper requires big parts. One such part is the 26-inch Hub shown in the section drawing, having the minor diameter and the 79 involute spline teeth Lapointe-Broached from the solid in a steel forging. Even with an I.D. of more than eight inches, and tolerances held extremely close, the broaching is easily completed in 2¼ minutes floor-to-floor time.

You may not be machining such big parts . . . but it's a safe bet that whatever you may be doing by milling, shaping, grinding or other conventional metal-removing method *can be Lapointe-broached for less.* You get a better finish, high production, and a perfect part every time — no spoils.

Comparing all methods of metal removal, the greatest potential for cost reduction exists in the field of *broaching.* Why not investigate? An experienced Lapointe Engineer will gladly call on you at your request.

Introduced to the earthmoving industry February 1, the new 631 Tractor-Scraper is the largest four-wheel earthmover ever built by Caterpillar. Heaped capacity is 28 cubic yards of earth.



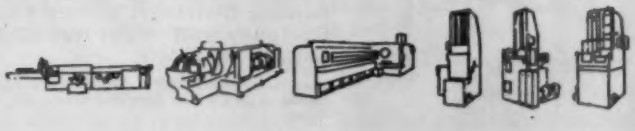
Section Drawing of Hub

This is a heavy broaching operation requiring a 1200-pound **LAPOINTE BROACH** which is sectional type, with cutting sections 64" long. Hydraulically operated broach support pan eliminates all manual handling of the broach on this HP-75 Horizontal Hydraulic Broaching Machine, 37½ ton capacity, 72" Stroke. Overall length 206" (over 17 feet). Machine has variable broaching speeds from 5- to 20-f.p.m.

THE LAPOINTE MACHINE TOOL COMPANY

HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*

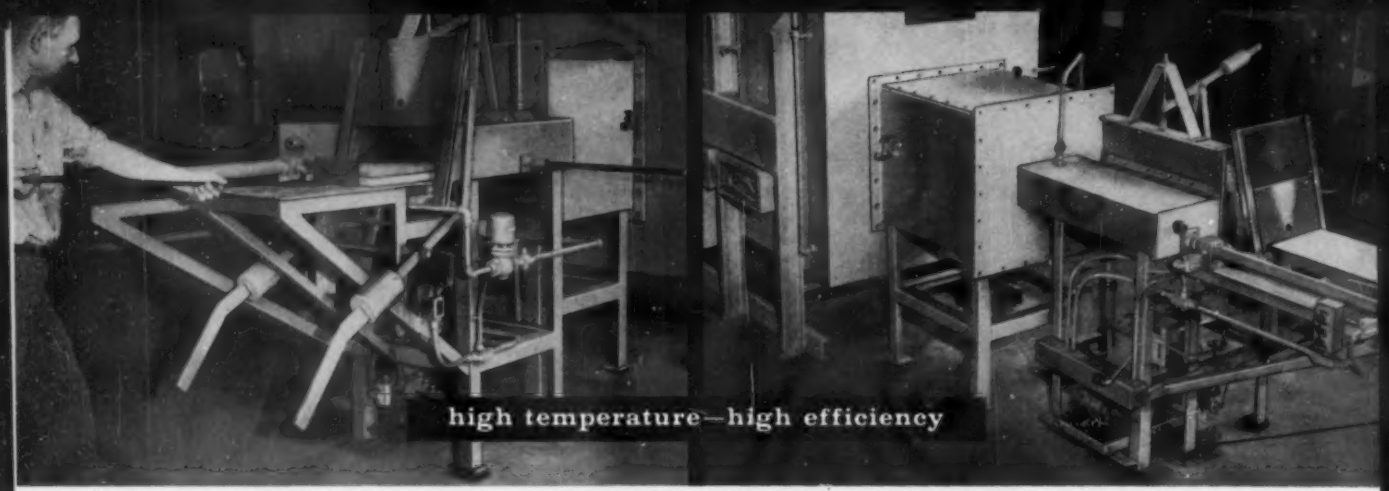
THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES



LAPOINTE

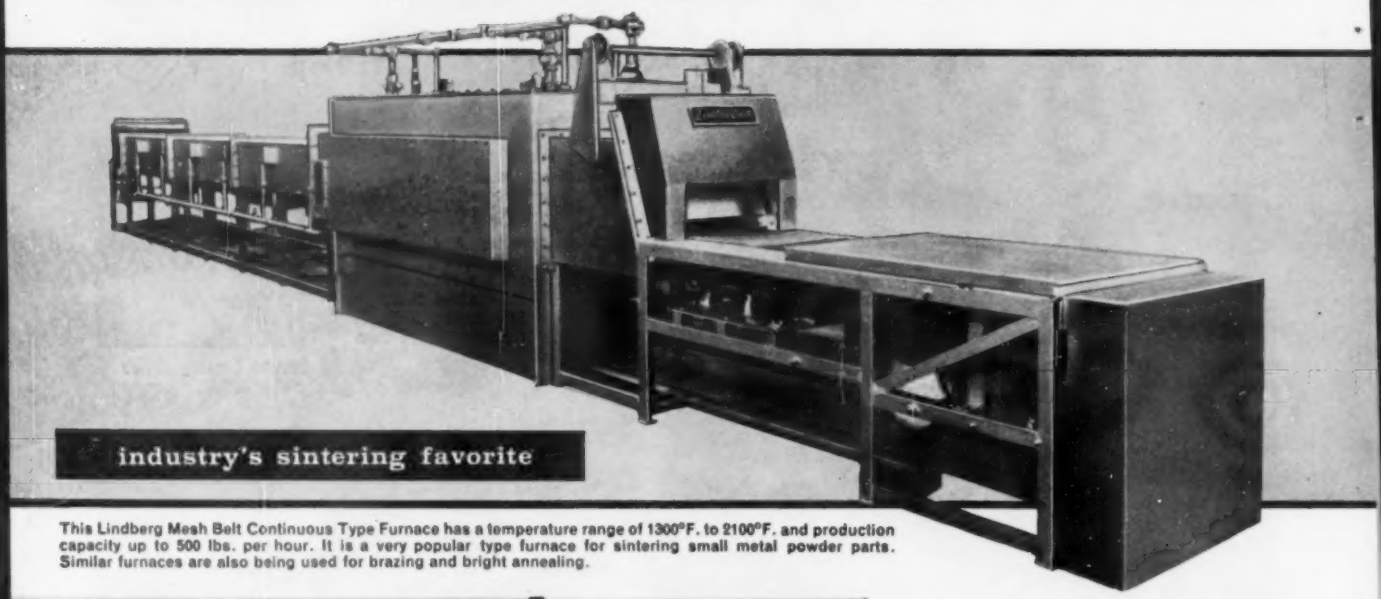
known to be the best in

BROACHING



This new Lindberg Molybdenum Element Pusher Type Atmosphere Furnace has a maximum temperature of 3000°F. with 60KW input. It embodies high temperature refractories suitable for low dew point without muffle and is ideal for sintering stainless steel compacts in hydrogen or dissociated ammonia. Furnace provides side loading and discharge ports with purging chambers. Installation at right also shows conveniently located ammonia dissociator and control panels.

If your production processes require sintering you can depend on getting exactly the right equipment for your needs from Lindberg's comprehensive line of dependable, efficient, production-proven furnaces



This Lindberg Mesh Belt Continuous Type Furnace has a temperature range of 1300°F. to 2100°F. and production capacity up to 500 lbs. per hour. It is a very popular type furnace for sintering small metal powder parts. Similar furnaces are also being used for brazing and bright annealing.

Lindberg Roller Hearth Continuous Type Furnace handles loads up to 2200 lbs. per hour in temperature range 1300°F. to 2100°F., for bright annealing, silver brazing and sintering metal powder.

Lindberg Hand Pusher Batch Type Furnace has a temperature range of 1300°F. to 2500°F. Also sintering capacities from 25 to 300 lbs. per hour available.

For full information on the furnaces illustrated and Lindberg's complete line of sintering and brazing furnaces, just get in touch with your local Lindberg Field Representative (see classified phone book) or write direct. Please remember, too, that Lindberg offers a variety of Atmosphere Generators to provide, efficiently and economically, the proper atmospheres recommended for use with our sintering furnaces. Heat Treating Furnace Division, Lindberg Engineering Company, 2447 West Hubbard Street, Chicago 12, Illinois.

Los Angeles plant: 11937 S. Regentview Avenue, Downey, California. In Canada: Birlefco-Lindberg Ltd., Toronto.

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heat for industry

BATH *Tap'n Gage* TIMES

A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 8

Subject: Helpful Hints for Successful Tapping

The Drilled Hole:

The drilled hole should be of proper size; drilled straight and not out of round. For most applications, a thread height of 55% for smaller taps and 75% for larger taps will have more than sufficient strength. Excessive thread height may result in torn threads and high tap breakage. Tap drills used in malleable metals such as soft stainless steel, soft aluminum, copper, monel metal etc., should be the largest size permissible because these metals tend to flow to the crest of the minor diameter while being tapped. This results in a small minor diameter after the tapping operation. Where it is possible, bottoming holes should be recessed or drilled deeper than it is necessary to tap. When tapping a hole with a taper pipe tap, it is often helpful to taper ream before tapping. "Go" and "not go" cylindrical plug gages may be used to control the drilled hole size.

The Tapping Machine:

Use a tapping machine and tap holder suited for the work. Check the tapping machine spindle and holder for wear and alignment. If they are worn or out of line, oversize and bellmouth holes may result.

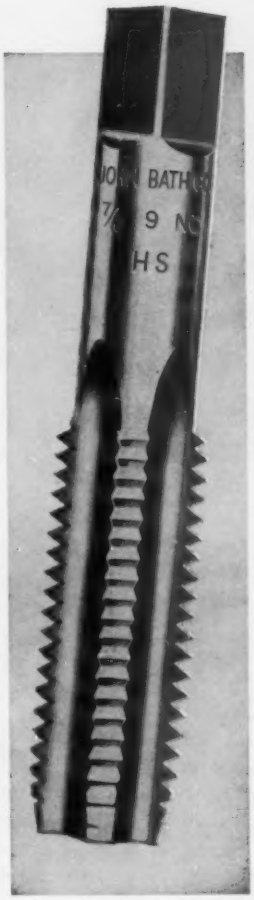
Lubrication:

The best lubricant for tapping depends on many variables such as the material to be tapped, the method of tapping and general conditions. The proper lubricant or cutting fluid can promote longer tap life, size control and higher tapping production. The correct lubricant can generally be determined by an oil company's representative who usually will make a survey and recommend the best lubricant for the specific tapping job.

Tapping Speeds:

There are many factors which affect proper tapping speeds, some of which are:

Material Factors: Thermo-conductivity of the material to be tapped and wall thickness as it affects heat dispersion; variations of carbon content of steel; hard spots in material; depth of hole to be tapped; thread height to be tapped.



Tap Factors: Major diameters, pitch and lead; style of tap; width of lands; amount of hook or rake; length of chamfer.

Mechanical Factors: Type of tapping machine and holder; condition of tapping machine; type of fixture; vertical or horizontal tapping (faster speeds for vertical tapping); method of feeding the tap; cutting fluid used and method of application. Generally the best speed for tapping is the highest speed that conditions permit.

Use a tap with the proper number of flutes, flute design, chamfer and pitch diameter for the job.

Avoid tapping a hole so deep that the flutes of the tap clog tight with chips. Tap breakage will result. When deep hole tapping is necessary, use one or more roughing taps and a finishing tap. Do not rough out a thread too close to the finished size. The finishing tap may bind in the thread and break; will rub instead of cut.

When starting to thread a hole, allow the tap to find its own lead. Do not attempt to force or retard the tap . . . this will cause a bellmouth hole.

Sharp taps are a must for successful tapping. Sharpen when necessary with the utmost care on one of the several types of machines on the market designed for this purpose. Do not sharpen taps by hand.

We have listed some of the most common tapping rules but there are many more depending upon the specific tapping job. Bath engineers will recommend proper taps and give tapping advice on application.

Clip and mail coupon NOW!

John Bath & Co., Inc. 28 Mann St., Worcester, Mass.

I would like to receive blueprints on the proper method of sharpening taps. Send to:

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- **Improved Muffling**—15 decibels quieter than comparable tools.
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Series 15 Grinders fill the bill—and offer manufacturers important new proof of tools to increase Annual Dividends on Payroll Dollars.*

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*Ask your AIRengineer for a convincing on-the-spot demonstration of how these new grinders—as well as all other Ingersoll-Rand air tools—can earn an Annual Dividend on your Payroll Dollars.

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Planned Annual Retooling increases output per man

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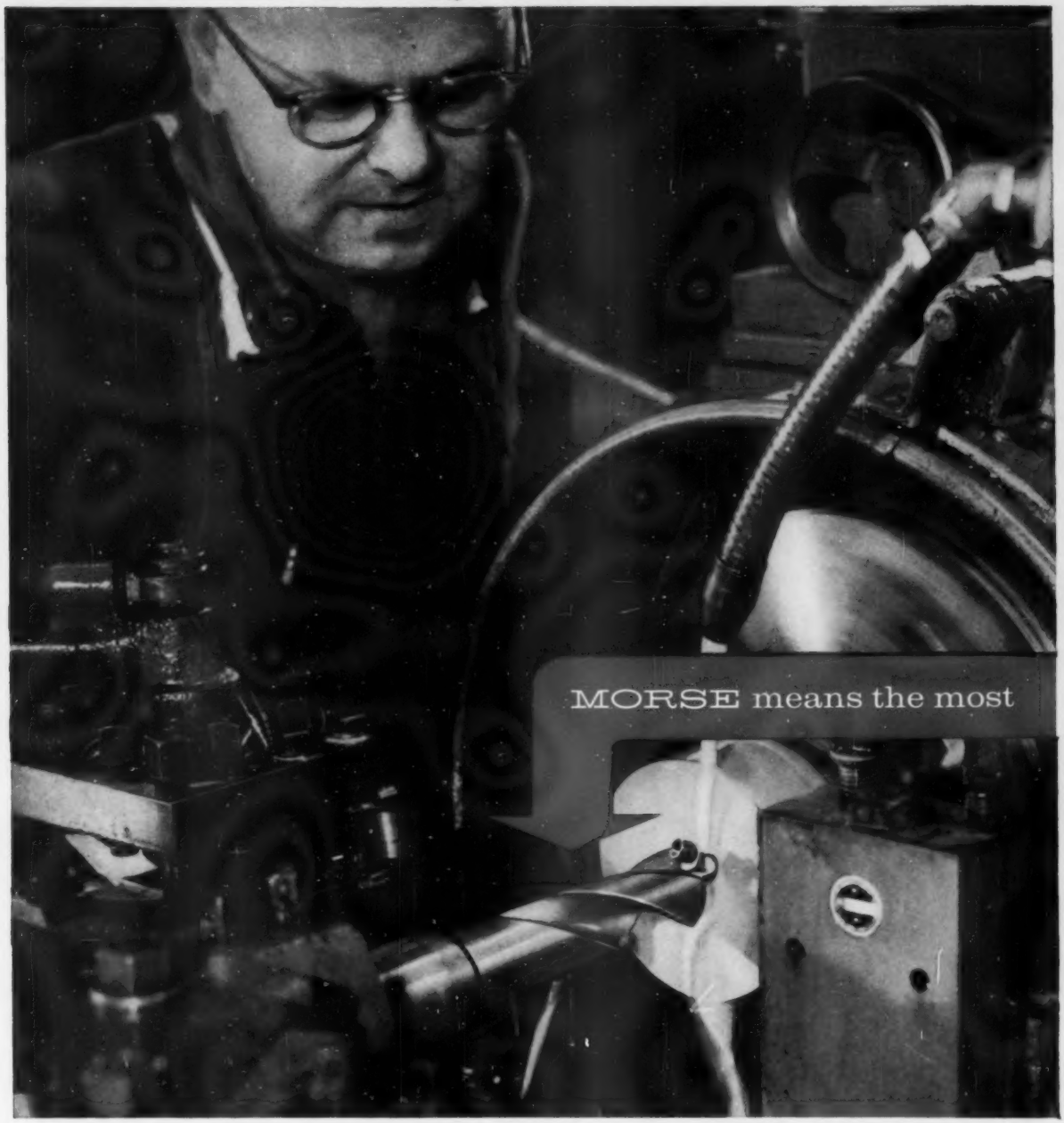

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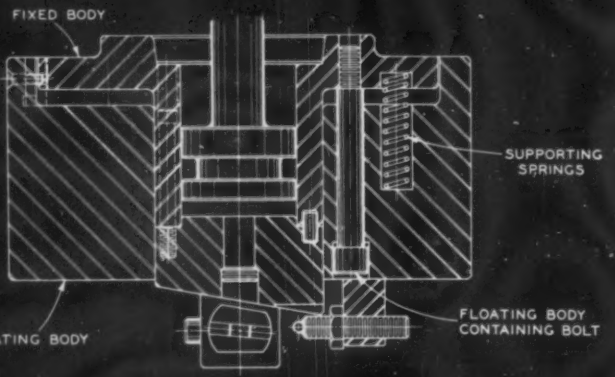
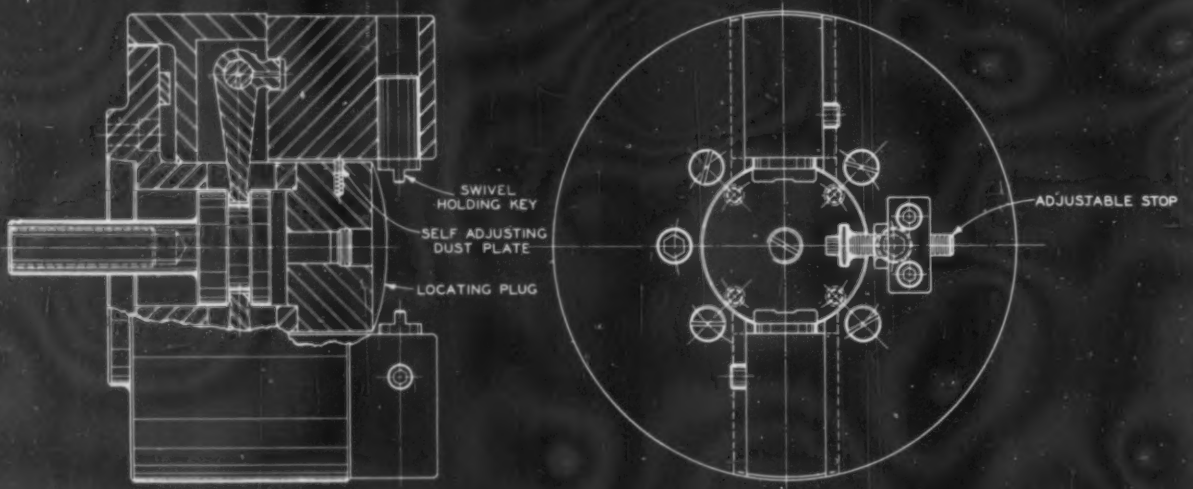


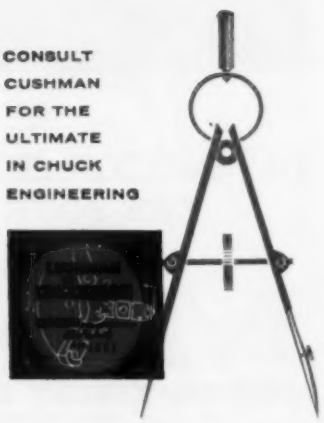


TO MEET [redacted] WORKHOLDING REQUIREMENTS

The assembly print reproduced above is but one of many examples of special chucks designed and engineered to meet most unusual workholding and machining requirements. Cushman Special Chucks are being used in many diverse industries enabling manufacturers to meet realistic production quotas, maintain close tolerances, and achieve lowest costs on both short or long runs.

If you have a workholding problem, consult Cushman. Your problem may have already been solved.

CONSULT CUSHMAN FOR THE ULTIMATE IN CHUCK ENGINEERING



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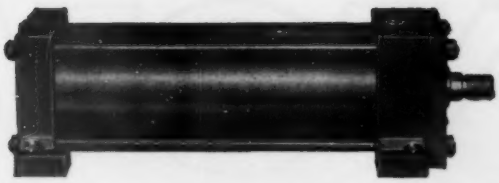
with PARKER-HANNIFIN One Source Engineering

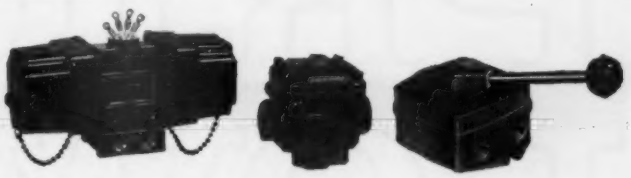
Your pneumatic system shapes up faster at the design stage when one man can discuss with you every component you'll need. But have you realized how much your Parker-Hannifin man can save you in money and air?

Just for instance . . . your valves don't have to be ¾" just because the cylinder size you select comes with ¾" ports. Your Parker-Hannifin man chooses valve types and sizes to suit the air flow you'll need. He'll show you too, how pressure control saves money and air, how a smaller lubricator is often a more efficient lubricator, and other money saving ideas. Then he'll show you ways to "tube up" and "hose up" a leakproof pneumatic system quicker, neater and at lower cost.

Call your nearest Parker-Hannifin sales office, or write direct for complete information.



Low friction, long packing life are money-saving features of the Hannifin Series "A" pneumatic cylinder, available in a full range of mounting styles and from 1½" to 14" bore, strokes to 20 feet. Hannifin cylinder application data and charts make selecting the right Series "A" cylinder easy. Get yours from your Parker-Hannifin man.



DUAL SOLENOID, 4-WAY

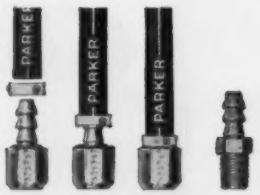
PRESSURE, 3-WAY

HAND, 4-WAY

CAM, 3-WAY

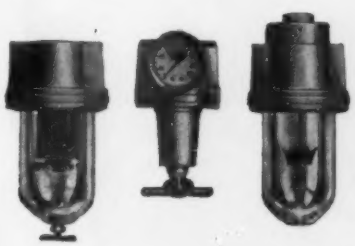
Use flow factors as money-savers—your Parker-Hannifin man can show you how. They help you to avoid "oversizing" your valves. Hannifin's new Valve Finder gives "C_V" ratings for every valve in the line, makes it possible for you to take full advantage of the extra air-flow capacity in Hannifin air valves. Get your copy today.

Pneumatic systems tube up fast with Parker "Intru-lok" tube fittings. Use them with copper, nylon or "Parker-POL" polyethylene tubing. Just insert the tube and tighten the nut for a leakproof "bite-type" joint.



Another time-saver is "Push-lok", the Parker hose-and-hose-fittings combination for pressures to 250 psi. No tools needed. Just push this hose on these hose fittings. They won't blow off, ever, not at twice 250 psi.

One air line connection installs the Hannifin Air Motor . . . an integral solenoid valve controlling a fast, rugged double-acting air cylinder. Built-in speed controls adjust piston speed in either or both directions.



You will save both air and money with Hannifin "Crown" air line filters, pressure regulators and lubricators. Let your Parker-Hannifin man show you how they pay for themselves by making it possible to get all the air flow you need at the exact pressure that will best do the job. "Crown" filters and lubricators will bring further savings through reduced equipment maintenance.

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NEW Bullard Mult-Au-Matic Type "M"

Contrary to the general upward trend in the cost of new plant production equipment, The Bullard Company is offering the *new* Type "M" Mult-Au-Matic at a price which is *lower than competitive methods.*

Designed and built according to exacting Bullard standards, the *new* Type "M" Mult-Au-Matic incorporates many new features of rigidity, accuracy and productivity which have made this machine famous the world over.

For complete information on the *new* Bullard Type "M" Mult-Au-Matic, call your nearest Bullard Sales Office or Distributor or write to

The Bullard Company, Bridgeport 9, Conn.

NEW!

Logan | 14" LATHES
BEST DOLLAR VALUE
IN THE LATHE FIELD

These new Logan 14" swing lathes are **DEPENDABLE.** Their capacity permits a broad range of machining operations. They have a 14⅝" swing over bed, a swing over saddle cross slide of 9", and a center distance of 28". Logan lathes are **ACCURATE.** The ball bearing spindle has a 1⅜" hole and a draw in collet capacity of 1 1/16". The variable speed drive (40 to 1400 RPM) adjusts while lathe is running—no need to stop and shift belts! Also, the two V-ways and flat ways of the lathe are precision ground. Logan 14" swing lathes are **RUGGED.** The 10" wide and 56" long lathe beds are braced by oversize ribs to withstand torsional stresses. Feature for feature, the Logan 14" lathe is your best dollar value. The proof's in the product. No other lathe in this price category offers you this same big work capacity with variable speed drive. Write today for complete specifications.

Model 6510
$1,775.00
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Logan

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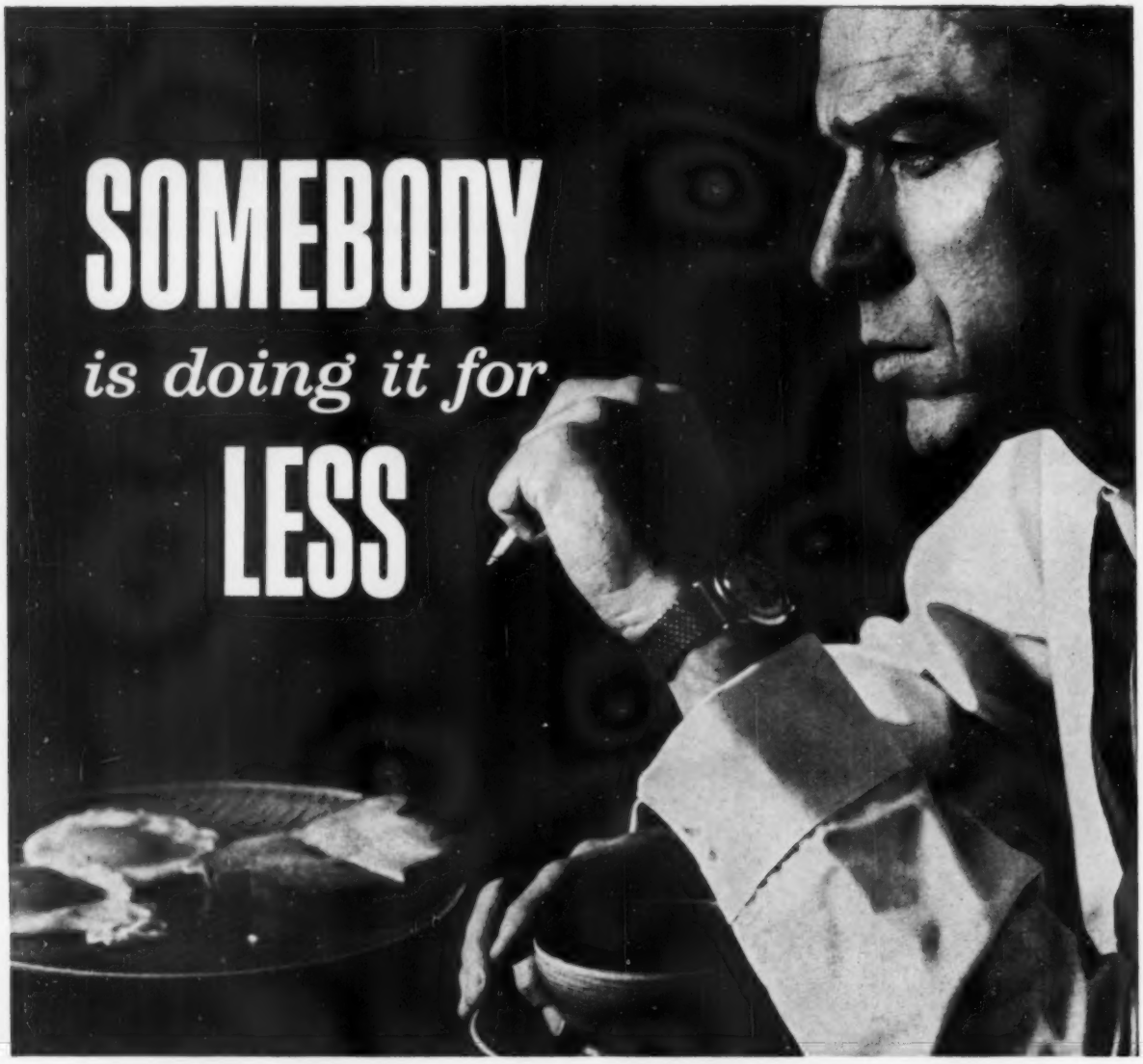

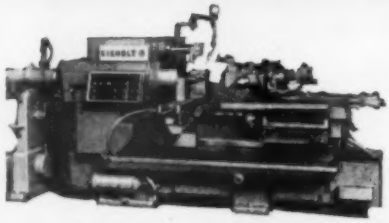

GISHOLT MASTERLINE AR TURRET LATHE Converts for bar or chucking work in less than one hour. Sets up like a turret lathe, from the front—no gears to change—uses same standard tools. Cycle setting is learned in less than a day. Compare these extras: greater capacity at lower original cost than any comparable automatic; automatic withdrawal for chip clearing in deep holes; internal threading with solid taps requiring spindle reverse; external threading with self-opening die heads and automatic re-cocking; reverse feed and individually adjustable dwell to all tool stations; 16 spindle speeds and infinite feeds—none lost when threading. Optional: 8-sided turret; overhead cut-off slide or swinging stock stop; automatic recessing slide tools; JETracer® with turret slide tools.

Ask your Gisholt Representative for a desk-side demonstration, or write for Catalog 1224.

With recent developments in automatic machining, many manufacturers—maybe your toughest competitors—are cutting costs substantially.

Even small runs are going automatic—both bar and chucking work too! All this with the Gisholt AR® Turret Lathe at little more than the cost of a hand-operated turret lathe.

This is no exaggeration: the Gisholt AR can cut your *direct* machining costs by 25% to 40% on work now handled on manual lathes—can give you *indirect* savings in tooling, inventory, setup, inspection, materials handling and floor space. Investigate AR—your best answer to the cost-profit squeeze.

GISHOLT
MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

Turret Lathes • Automatic Lathes • Balancers • Superfinishers® • Threading Lathes • Factory-Rebuilt Machines with New-Machine Guarantee

Progress Is in Your Hands

Progress means change. Our Society has made many changes and has seen significant progress during the past ASTME year. Under the leadership of our chapter chairmen and their officers and committee chairmen, thousands of us have advanced our knowledge of manufacturing technology. Many thousands more have passed up golden opportunities to advance themselves by failing to participate in chapter activities.

New chapter chairmen have been installed with their supporting teams of officers. Much will be expected of the "new administration." We realize we are facing a tougher competitive race every day for business and are eager to learn how to hold our own and to make personal progress.

Our future progress as members will be in your hands, leaders. It is up to you to set a shining example by participation in chapter activities—regular monthly technical meetings, executive committee meetings, conferences and seminars that are held in your area. Programs for each chapter should be carefully planned around the specific needs of industry in each area. Such programs serve members' needs, too. Each speaker should be carefully selected to present his subject effectively. Compromising on a low-caliber speaker hurts the chapter. Members will not attend if they have heard a series of poor speakers. Many drop their membership because of disappointment in the caliber of chapter meetings.

I salute all the outgoing chapter chairmen and officers who have served so well and to whom we owe so much.

My hat is off to the new administration—progress is in your hands.

Dale Long

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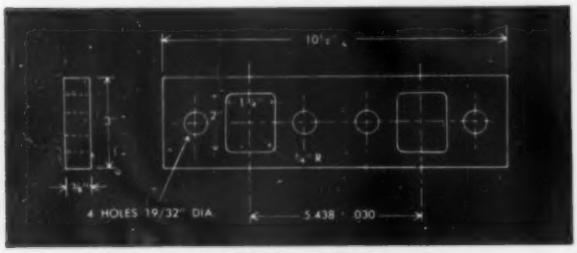
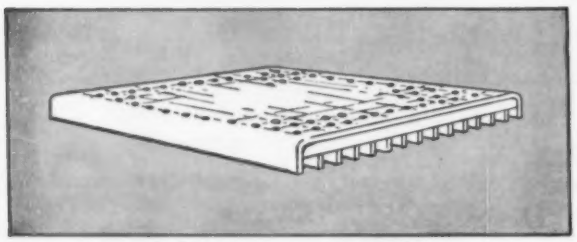


Saved: $100 per thousand

PROBLEM: Muffler manufacturer required accurately finished mounting plates made from ⅜" x 3" bar. Cutting bars to size, burning 1¼" x 2" holes and drilling four 19/32" holes proved time-consuming and expensive.

SOLUTION: Ryerson recommended that they eliminate cutting, burning and drilling operations by stamping the part from Ryerson forming-quality plate. One operation instead of three cut costs $100 per thousand pieces and quickly justified the small initial investment in dies.



Suggestion saves 85%

ASKED FOR: Customer wanted 1" hot rolled plate to cover about 80' of 24" open trench. Plate was to be cut into 24" x 27" segments—each containing 900 ⅜" holes to filter the product.

RECOMMENDED: After studying application and costs, Ryerson recommended a design combining perforated light plate, formed to channel shape, and grating for structural support. Ryerson's experience and imagination saved 85% of the original cost.

Machine cut rings solve problem

PLATES REQUESTED: Ryerson was asked to bid on supplying ¼" Type 410 stainless in 27½" square plates. Material was to be used for orifice plates for 16" burner, subjected to elevated temperatures.

RINGS RECOMMENDED: Going beyond material specs, the Ryerson representative found that the customer intended to cut plate into 27¼" diameter length with 13.120" bore—and then mill 12 slots in outer diameter for expansion relief. Knowing the application, Ryerson recommended supplying machine-cut rings in which slots could then be punched rather than milled. Production savings enabled switching to Type 304 at less cost than Type 410 with slots milled.

2 metalworking machines for the price of 1

A fabricator of stainless steel kitchen equipment was recently in the market for a new squaring shear. The one under consideration had a gap-type frame which would enable him to do an important notching operation—necessary for certain sink tops. After careful study, a Ryerson machinery specialist recommended *two* pieces of equipment instead of one at no increase in total cost. The first, an under-driven shear. The second, a universal-type sheet metalworking machine that would do the required notching, plus many other jobs—adding versatility to the entire operation.

Production upped 30%

BEFORE: Job shop was using MT 1015 tubing in the manufacture of this coupling. Machinability was satisfactory, but rising costs of operation led to a search for ways to economize.

AFTER: Careful study by the Ryerson representative brought about a change in material. He recommended using Ledloy® 170 tubing, which increased machining speed to 170 sfm and stepped up production 30%. Ryerson's stocks include the widest range of fast-machining alloys.

STEEL • ALUMINUM • PLASTICS • MACHINERY

RYERSON STEEL®

Joseph T. Ryerson & Son Inc., Member of the INLAND® Steel Family

the role of
SCIENCE
—in American manufacturing progress

By A. B. Drought
Dean
College of Engineering
Marquette University
Milwaukee, Wis.

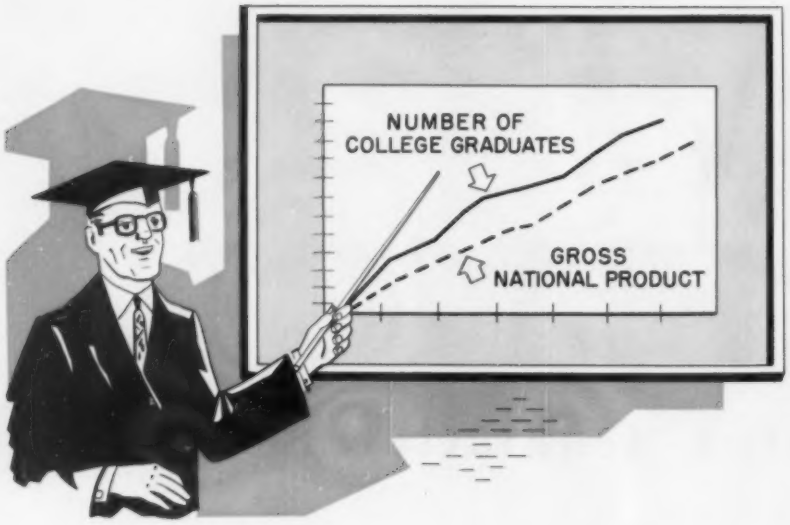
Future improvements in American productivity will be largely dependent on the application of science to manufacturing. This depends in turn on the availability of large numbers of scientifically trained tool and manufacturing engineers. The universities can serve the needs of industry in two ways: by performing basic research and by graduating well-qualified engineers in the manufacturing field.

TRADITIONALLY, American universities have paid little attention to manufacturing. Until recently, only a few university research programs covered the processing of engineering materials and manufacturing technology. Few engineering curricula have included courses in these subjects. Some engineering colleges have, of course, given shop courses covering the rudiments of machine operation. In these courses, theory was usually neglected, primarily because few of the ideas had been proved scientifically. Occasionally, a school offered a course in tool design, usually when there was a person on the faculty who, as a result of his consulting practice, was interested in the subject or made it his hobby.

Few real scholars turned their attention to tool and manufacturing engineering subjects because, historically, the developments in the processing of materials were empirical in nature. Scholars were not alone in thinking that these problems were of a nonacademic nature. Tool and manufacturing engineers, too, were satisfied that better processing could be attained only by trial-and-error methods.

This type of thinking has not been limited to the processing of materials. Another excellent example is the treatment of electronics in engineering curricula. Except for some work on the electronic properties of vacuum tubes in physics departments, electronics was largely ignored by most universities prior to World War II. As a result of experiments, improved electronic circuits were developed —often by radio amateurs—but few efforts were made to develop scientific theories in the field of electronics. Progress was slow.

When professors in engineering colleges began to apply mathematical principles to the operation of electronic circuits, by analysis they could explain some of the "strange" responses that were observed in the field. Analysis provided understanding, and understanding made it possible to develop more efficient circuits and circuits that could do entirely new things. The frequencies in use increased from a few million cycles to 10,000 megacycles during World War II as a consequence of new theories



The number, quality and utilization of educated people in a country is the most meaningful index of that nation's wealth-producing capacity.

developed in engineering schools. Since World War II, frequencies have increased to 200,000 megacycles and tomorrow the gap will be closed between today's frequencies and the visible spectrum.

The uses of electronic devices have been extended and it is possible that the metrology of material processing research will soon depend on the employment of radio frequencies which we are now for the first time able to generate and control.

Success in this field was made possible primarily because university scholars saw in the problems a real challenge and a chance to make a major contribution to engineering science. A similar historical sketch could be given for the mining and petroleum sciences. In each case, once the scholar was convinced that the problems were within his province and proper to the university, significant—and accelerated—progress was made. Something similar can be expected to happen in the tool and manufacturing engineering fields.

Today's Challenges: Today, with the advent of the Space Age, industry is faced with the challenge of developing new engineering materials. In order to do this, scientists are eagerly trying to understand the nature of materials. As yet, little is known as to what mechanism within a piece of material provides the properties of strength. Several theories have been offered and the testing of them has begun.

Not only is the prospect of creating new materials fascinating to engineers, but equally challenging is the processing of those new materials. In the production of missiles, for example, the machining and processing of components is still mostly done by toolroom methods. New techniques must be developed to permit faster and less costly operations.

There are two main forces at work that will require the solution of these problems by tool and manufacturing engineers. The first of these is our national security. It is known that research associations in England, Germany and Russia have been set up to develop improved processing methods. The Production Engineering Research Association of Great Britain is one of these. There are at least two Russian research institutes for machine tools, one of which has a staff of 4000 people and the other more than 2000 people. These figures include shop employees who build experimental machines, of course, but it is reported that the majority of the employees are technicians, designers and higher-grade research workers. It is also reported that these are only two of many similar centers for industrial research in Soviet Russia.

The second force that makes it necessary for American industry to develop better materials and more efficient production methods is economics. Methods for processing costly materials with less waste must be developed. And machine-tool efficiency must be improved.

Most important is the need to produce more reliable parts and assemblies, to closer tolerances and with lower labor time per unit. This will be necessary not only to meet domestic competition, but to meet competition from abroad. Russia is already producing standard types of machine tools at lower cost than the manufacturers of Western Europe. It has been reported that at least one Russian plant is producing a lathe every 15 minutes with one-third to one-quarter the labor man-hours of comparable plants in Western Europe. Comparable figures for American lathe production are not available.

University Programs: Despite tradition, scholars have gradually become interested in the processing of materials. In Germany, for example, chairs

for the study of machine tools and industrial processing were established in the second decade of this century. Teaching in American universities, on the other hand, has concerned itself primarily with the machining process, with only slight emphasis on machine tool design. Until recently, there was practically no research work except on the machinability of metals. The usual approach was empirical and dealt primarily with the determination of the best cutting conditions. Little change in this approach was apparent in either Europe or America during the Thirties.

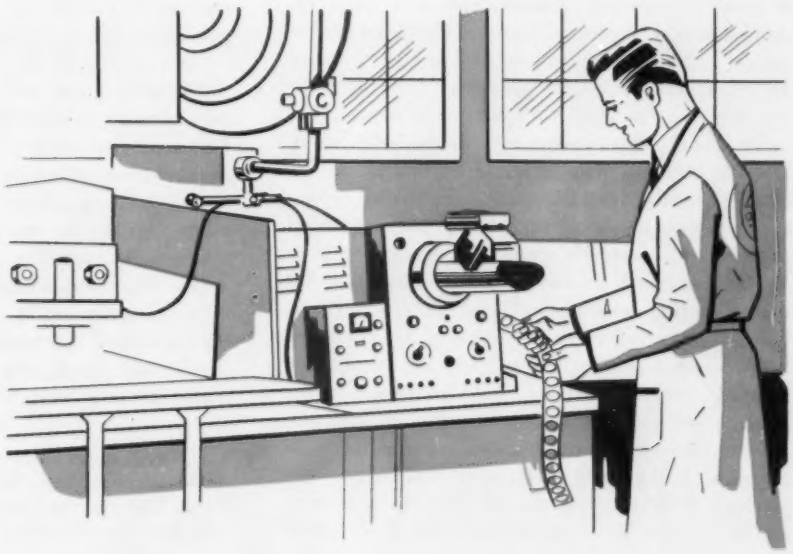
University researchers in America became seriously interested in metalcutting during and following World War II. High-power machining and the development of automatic machines attracted their attention. Further, the development of production techniques for machining high-strength materials, heat-resistant materials and radioactive materials could not be accomplished by empirical methods alone. With the aid of more accurate instruments and the use of radioactive tracer elements, basic studies of the mechanism of the machining process were conducted. Studies of the forced and self-excited (chatter) vibrations in cutting tools and major machine tool components were started. New and more accurate instruments were developed. Grinding, welding and forming processes were also investigated from a scientific point of view.

European universities have been ahead of American universities in formally recognizing the need for courses related to manufacturing technology. All German technical universities have chairs and institutes for machine-tool engineering and for production engineering. Some of the English universities have similar chairs, but they are still rare in American universities.

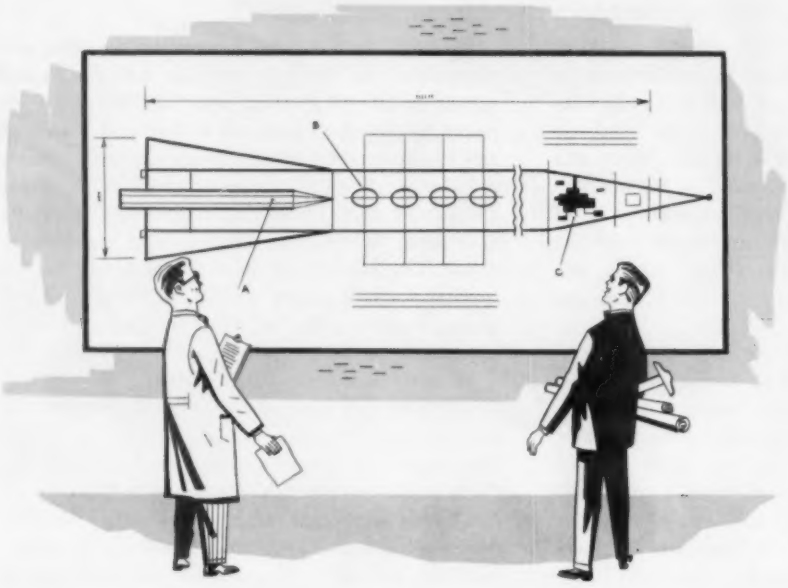
Presently, in European universities, teaching and research in the fields of machine tool design and operation are progressing rapidly. Efforts are directed toward both standard and special machines, and to attachments and accessories as well. Courses are also taught on the theory of metalcutting. These include the study of the machinability of materials, tool wear, lubrication, cooling and servomechanisms. The influence of friction and temperature is studied. Certain aspects of the solid state, as well as the metallography and crystallography of workpiece materials are investigated.

Students also learn—in the laboratory—the use of standard and high-precision instruments for the measurement of lengths, angles, surfaces and so on. This is part of courses in metrology. University students in Europe also take courses in automatic control. This particular area, incidentally, is well-developed in both Europe and America. The subject can best be understood when a sound mathematical approach is used. Courses in automatic control are often titled: "Theory of Automatic Control" or "Servomechanisms." Courses in statistics and quality control, which have a close relationship to the functions of the tool and manufacturing engineer, are also offered to university students here and abroad. Closely allied to these technical courses are courses in management and in industrial economics.

Teaching and Research: In this article, no differentiation has been made between teaching and research. In evaluating a school, greater interest should be centered on individual faculty members and their contribution to knowledge than on the particular courses listed in the catalog. This does not



University research in basic manufacturing problems can complement applied research in industry.



The development of new engineering materials—and of ways to process these materials—presents a real challenge to scientists and engineers.

mean that good teaching is unimportant, nor does it mean that all researchers are good teachers. Unless a teacher is engaged in a scholarly activity and making a contribution to knowledge in his field, he cannot be a good university teacher. Departments composed of intelligent men who are dedicated to seeking knowledge—and communicating knowledge—provide the best atmosphere for learning.

Filling Industry Needs: There is a growing need for engineers who are cognizant of the fundamental problems in metal processing and manufacturing. Many of the engineers who fill this need in the near future will be recent university graduates. A few will have been exposed to manufacturing problems through courses of study in industrial engineering. Others, having a basic engineering background, will pursue additional studies either at the undergraduate or graduate level to better prepare themselves for work in industry. An engineer does not finish his education when he receives his diploma, particularly in the fields of interest to tool and manufacturing engineers. The explosive growth of technological and scientific knowledge makes it necessary for tool and manufacturing engineers to constantly study new developments.

Many of the technical personnel needed to fill manufacturing positions will not be graduate engineers—they will come from among the graduates of two-year technological courses and apprentice training programs. They will be people who, through self-imposed study, tutorship or management-sponsored training courses, have acquired a technical background that qualifies them for upgrading. With the fast rate of growth in science and technology, the upgrading of trained personnel will help to fill the consequent demand for more engineers and engineering technicians.

There is no need for establishing large government research centers—as Russia has done—to perform work in the manufacturing field. The universities, working with industry, can do the job.

There are numerous ways in which industry and education can cooperate on problems of common interest. Progressive companies have recognized the need of a scientific basis for their operations. Their scientists and research engineers are engaged in work that is intended to provide a scientific approach to many purely industrial problems. These scientists and engineers can make a real contribution to engineering education or academic research. They can, for example, teach advanced engineering courses on a part-time basis and they can actively participate in curriculum development and research—basic and applied.

Similarly, large and complicated projects involving areas of new technologies could well be handled by university-industry teams, with university researchers working on basic problems and industry working on practical applications. This would often provide the most efficient approach to the solution of processing problems.

One final point: Knowledge—whether acquired in a university or by self-study—is the only real capital today. The number, quality and utilization of educated people in any nation is the most meaningful index of that nation's wealth-producing capacity.

Note: Readers are encouraged to write to Dr. Drought or to the editors of THE TOOL AND MANUFACTURING ENGINEER on the subject of engineering education. Your ideas on this subject are welcome!

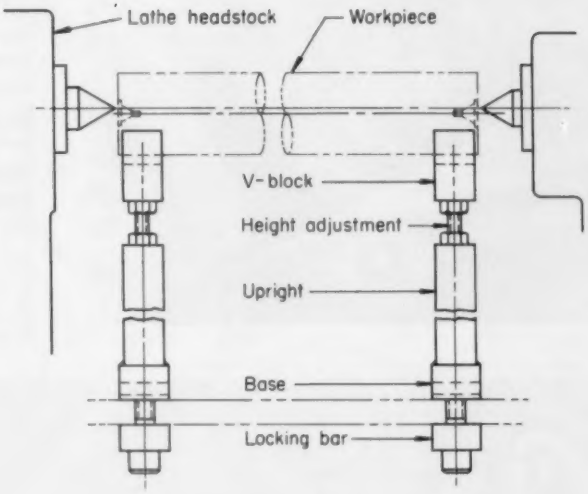
Gadgets

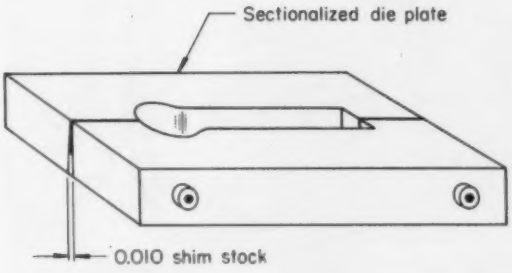
Ingenious Devices And Ideas

Work Supporter Speeds Machine Loading

Loading and unloading of heavy parts for turning and boring operations are facilitated by this work-supporting device. (Although two are shown, one is sufficient in most cases.) Consisting of a base, an upright and a V-block, the supporter can be raised or lowered to requisite height by locknut adjustment. After a part is loaded, the support can easily be removed by loosening the locking bars.

Roger Isetts
Kenosha, Wis.





Shim Design Cuts Diemaking Time

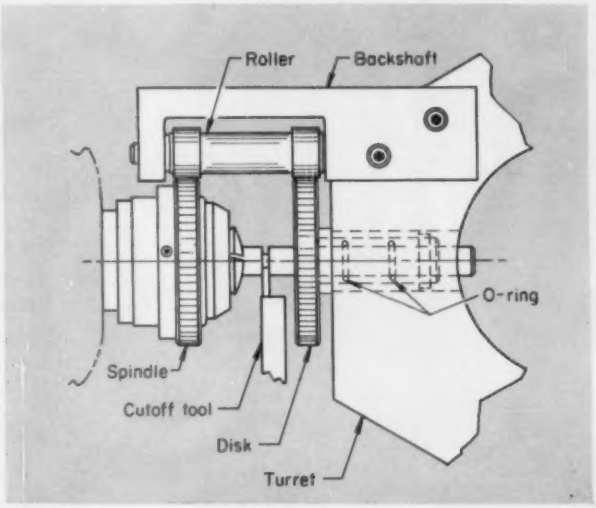
Time spent in relieving die sections in short-run blanking dies can be minimized if the die plate is sectionalized and shimmed as shown. Resulting angular die walls obtained in this manner provide ample slug relief for most purposes. After screwing the sections together, the diemaker need only grind the top and bottom surfaces to assemble the die.

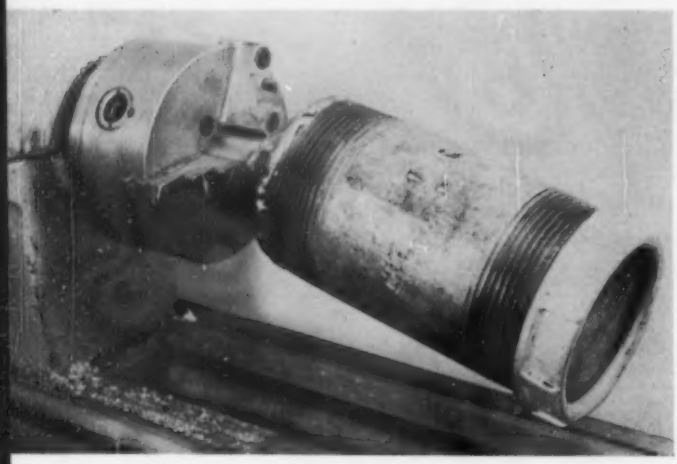
John M. Breen
Pittsburgh Chapter

Workpiece Support Improves Cutoff Operations

The supporting device illustrated produces smooth ends on turret lathe parts. This is accomplished with a roller which transmits the motion of the headstock spindle to the outer end of the workpiece by means of a serrated disk. The disk is secured to a support tube which is a running fit in a turret bushing. Held securely by O-rings in the tube, the workpiece is supported and rotated at both ends during cutoff. This enables the parting tool to impart a good finish to both sides of the groove.

Clint McLaughlin
New York, N. Y.





Lathe Operates Tumbling Device

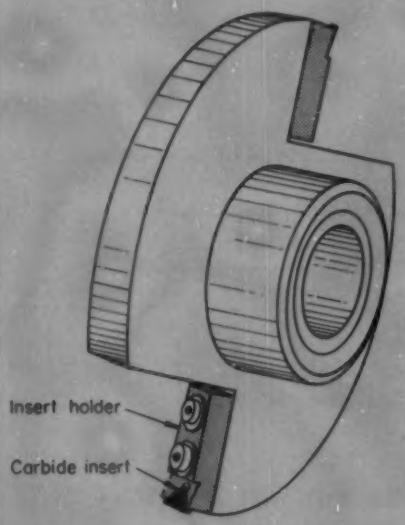
Designed for operation in a lathe, this tumbling barrel is useful for deburring and polishing small parts in experimental shops. Three basic parts are required: a pipe of suitable diameter; an end plate for chucking; and a threaded cap for loading and unloading. When mounted in a lathe, the barrel—offset from the lathe axis—tumbles the parts with a rotary motion while providing a constant end-to-end motion of the load.

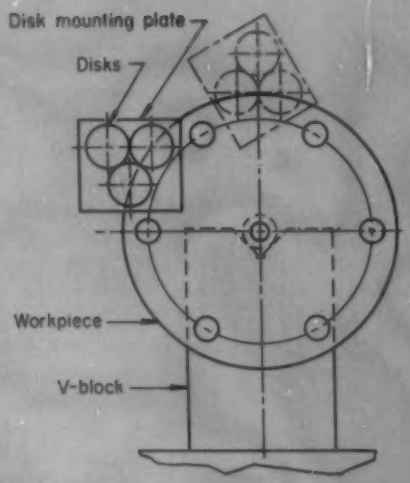
H. J. Gerber
Member-at-large
Stillwater, Okla.

Flycutter Uses Throwaway Inserts

Essentially a double-armed flycutter, this milling device utilizes throwaway inserts to hold accurate slot and keyway sizes. Variations in slot sizes are obtained by an adjustable insert holder which can be rotated within prescribed limits.

F. B. Murphy
Grove City, Pa.



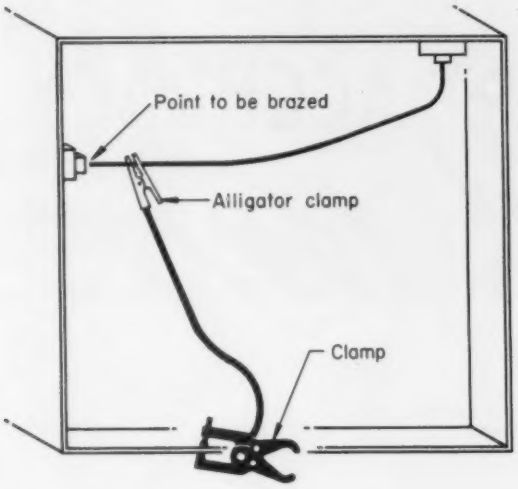


Improvised Hole Spacer

Six-hole spacings—recurrent in many drilled components—can be held with jig-bore accuracy by use of this three-disk mounting plate. In use, the plate is mounted on the workpiece. Indexing is then accomplished by rotating the workpiece and indicating the disks parallel to the base.

M. W. Loftus
Chicago Chapter

Gadgets



Flexible Fixturing Device

Principal advantage of this gadget is its ability to maintain part alignment while freeing the operator's hands for brazing, soldering and crimping operations. Consisting of a vise clamp, a length of copper wire and an alligator clamp, it enables operators to obtain and hold alignment of connectors and adapters when doing internal cabinet work.

In use, the vise clamp is fixed to some convenient part of the cabinet. The copper wire is then bent to bring the alligator clamp in proper position for workpiece fixturing.

A. N. Marden
General Electric Co.
Syracuse, N. Y.

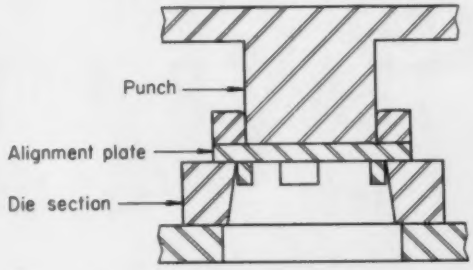


Plate Aligns Pinless Dies

Free-cutting dies operating without the stabilizing influence of guide pins can be held in alignment with locators of this design. Fabricated from a plate to which a number of blocks are screwed and doweled at critical locating points, the plate is also useful in eliminating cutting-edge contact when dies are stored.

Frederico Strasser
Santiago, Chile

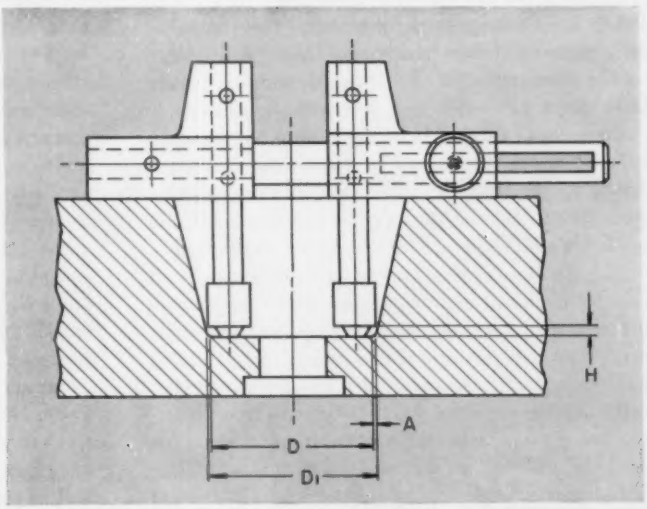
Remember the excellent gadget that you designed? The gimmick that got you around a difficult corner—or over a hump? We'd like to hear about it and consider it for publication. As an inducement we'll pay for any gadget published. Just send a short note and freehand sketch describing it to the Gadgets Editor.

Gaging Conical Holes

Sizes of conical holes—often difficult to inspect dimensionally—can be checked to close tolerances with this gage. Inspection consists of measuring the distance D_1 between two pins (over their major diameters) and substituting this value in the formula $D = D_1 - 2A$. The value of A is obtained by multiplying H by the tangent of the angle of the side.

Any number of variations in design can be made in this tool. The pins, however, should be designed as shown to avoid interference from fillets in the corner.

W. M. Halliday
Leics, England



how to improve TRACER LATHE ACCURACY

Part 1—Part Check

By J. Bryan, J. Bowerbank, E. Holland, O. Mohl

Lawrence Radiation Laboratory
University of California
Livermore, Calif.

With a six-step method described by the authors, it is possible to locate the sources of error in tracer lathe machining. Once located, these sources of error can be corrected, thus improving machining accuracy. This article is based on one of the papers to be presented at the ASTME 1961 Engineering Conference. Some 50 other outstanding papers will be presented at the Conference.

TO IMPROVE the machining accuracy of a tracer lathe, it is necessary to determine the causes of lathe error and how much each cause contributes to the total error of the finished part. A tracer lathe check to locate—and determine quantitatively—the errors of tracer lathe machining has been developed at the University of California Radiation Laboratory. After the errors are located, the type and extent of lathe or servo system modifications needed to improve accuracy can be established.

This check provides data on first-order errors. It can be demonstrated mathematically that second-order errors are not significant. The first-order error data analysis provides a means of correlating lathe errors with the error of a finished part. Correlation of error data shows what non-lathe errors are present and where a particular lathe needs reworking. With the information provided by the lathe check, the machining tolerance of a particular lathe can be determined with high reliability.

The tracer lathe check is divided into six steps—a part check, a twin disk check, a single disk check, a slides check, a spindle check and a template carrier check. The equipment needed to perform a lathe check consists of a linear measuring device, an angular measuring device, a parallel bar, a spindle ball, four half disk templates (two male and two female), and several clamps and fixtures to hold the measuring devices and accessories. The quality of the measuring equipment needed is determined by the accuracy required.

Tracer Lathe Operation: A tracer lathe machines a part by automatically following the bearing surface path of a template. The bearing surface path of the template is reproduced at the cutting edge of the tool by the vector resolution of the rectilinear motions of the lathe carriage, lathe cross slide and lathe tracer slide. With respect to their mountings, the three slides move with straight-line motion—the carriage slide along the bedway, parallel to the spindle axis, the cross slide normal to the spindle axis and the tracer slide at some angle to the spindle axis, usually 45 deg. This straight-line motion is the slide's drive motion. The cross slide is mounted on the carriage so that its motion with respect to the part being machined is the vector resolution of its drive motion and the carriage motion. The tracer slide, which supports the tool compound, is mounted on the cross slide so that its motion with respect to the part being machined is the vector resolution of its drive motion and of the cross slide and carriage motions.

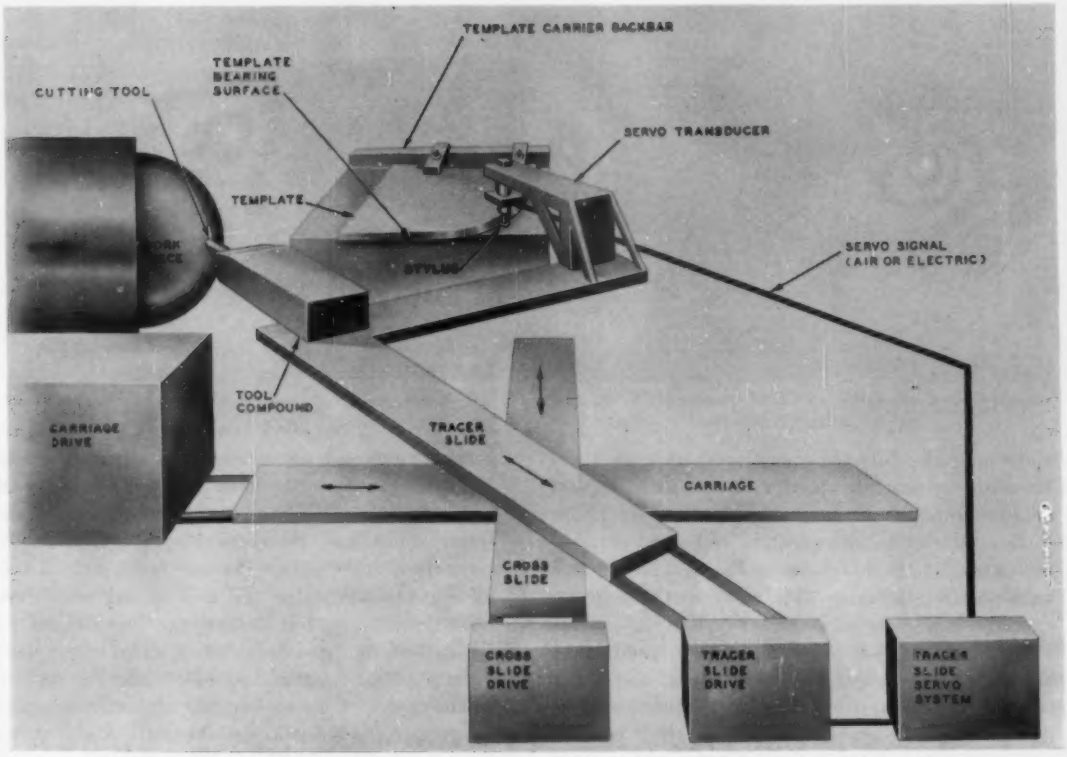


Fig. 1. Schematic drawing of tracer lathe. Contour of template is reproduced on workpiece.

The carriage and cross slide speeds are preset by the operator and are usually constant. The tracer slide speed is controlled by the lathe servo system and varies as necessary to maintain the position of the servo transducer with respect to the template bearing surface. *Fig.* 1 shows the relationship of the template, servo system and slides to the part being machined.

The vector resolution of the tracer slide motion when the lathe is following a half disk template is shown in *Figs.* 2, 3 and 4. *Fig.* 2 shows the vector resolution of the tracer slide motion with constant speed carriage feed only. The carriage vector is *OC*, the tracer slide vector is *OT*, and the tracer slide vector resolution, or tool vector, is *OR*. The point of tool contact is *O*. It is apparent that with carriage feed only, the tracer slide moves back with enough velocity, *OT*, to provide a resultant motion of the tool, *OR*, that is tangent to the contour of the finished part at *O*, the point of tool contact. With carriage feed only, the traced slide speed is 1.414 times the carriage speed at the pole and decreases to zero at the equator.

Fig. 3 shows the vector resolution of the tracer slide with constant speed cross slide feed only. The cross slide vector is *OC'*. In this case, the tracer

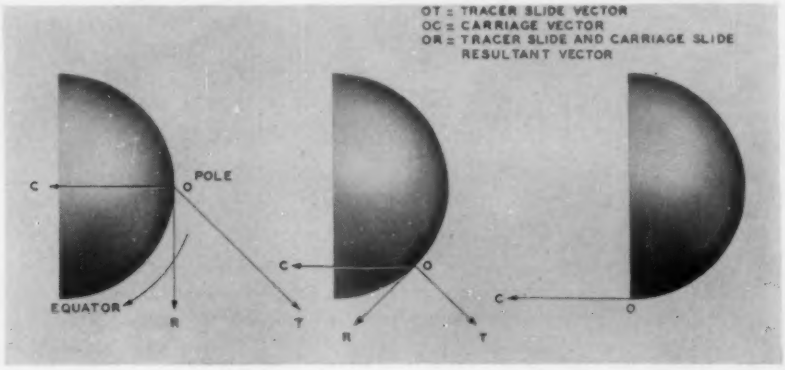


Fig. 2. Vector resolution of slide motion—carriage feed only.

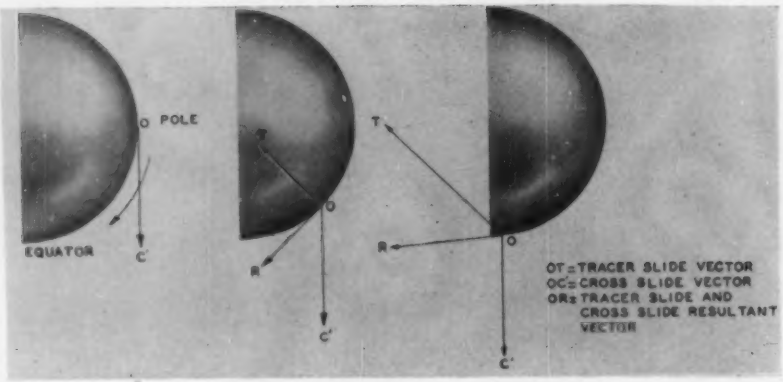


Fig. 3. Vector resolution of slide motion—cross slide feed only.

slide increases forward speed from zero to 1.414 times the cross slide speed to follow the template contour from pole to equator. The vector resolution of the tracer slide with constant and equal carriage and cross slide feed is shown in *Fig.* 4. The carriage vector is *OC*, the cross slide vector is *OC'* and the carriage and cross slide vector is *OC''*. In this case, the tracer slide moves back at a speed 1.414 times the carriage and cross slide speed, decreasing speed as the tool moves away from the pole position. At the 45-deg point, the tracer slide speed reaches zero, reverses, and increases forward speed until, at the equator position, it is moving forward with the same speed that it was moving back at the pole position. The point of reversal of the tracer slide motion is called crossover.

The path generated by the tracer slide and servo transducer in following the template bearing surface is not the same path as the template bearing surface but is a locus curve to that surface. *Fig.* 5 shows how a locus curve is generated as a ball-shaped stylus of a transducer rides a template bearing surface. The locus curve is traced by the center of the stylus and is the path that every point of the tracer slide (and, therefore, the tool) traces. To regenerate the template bearing surface from this locus curve, the stylus and tool cutting edge must have the same radius so that the line defined by the stylus center and the point of stylus-to-template-contact will be equal and parallel to the line defined by the center of the tool cutting circumference and the point of tool-to-workpiece-contact. *Fig.* 6 shows this relationship. In *Fig.* 6, *OA* and *O'A'* are equal and paralled. *OB* and *O'B'* are equal and parallel.

To regenerate the path of the template bearing surface accurately, the stylus and tool cutting edge must be perfectly round and equal in radius. The servo transducer must be stiff enough so that the varying forces against the stylus will be fully sensed by the sensitive element of the transducer. The servo system must be sensitive enough and stable enough to maintain the position of the frame

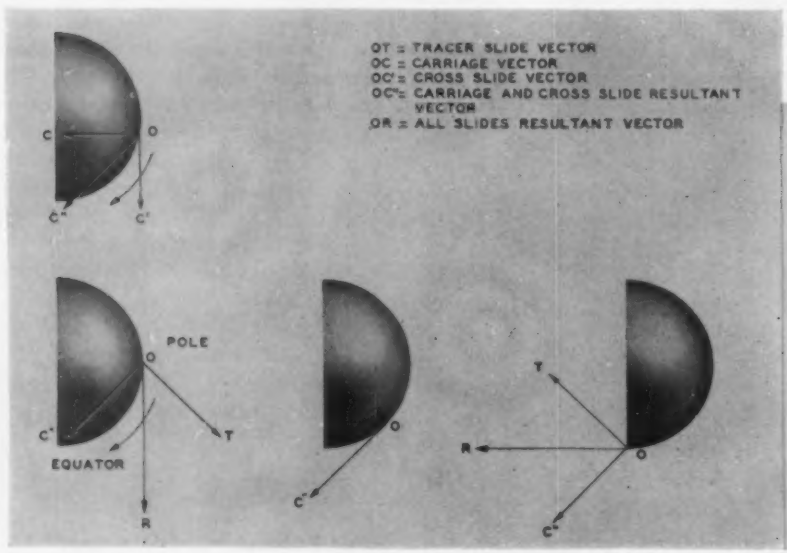


Fig. 4. Vector resolution of slide motion—equal carriage and cross slide feeds.

of the transducer to its sensitive element. The supporting arm of the servo transducer must be rigid so that stylus thrust and hose drag will not deflect the arm. The path of the slides must be straight throughout their travel so that perfect rectilinear motion is maintained. None of these perfect conditions exists in a lathe, so there is always some error in regenerating the path of the template bearing surface. One method of measuring this template bearing surface regenerated error is to perform the part check and the twin disk check.

Part Check: The part check measures how accurately the non-lathe elements of the tracer lathe machining operation function to regenerate the template bearing surface path. It measures the machining errors resulting from imperfect tool geometry, tool thrust, tool wear, chucking pressure, part distortion, operator error and other non-lathe causes. It is a measure of the composite transfer error between the no-load tool path and the finished part contour and will normally vary from job to job.

Any template can be used to measure this transfer error. To do a part check, a part is carefully machined to the template. Some suitably accurate linear measuring device is then placed at the tool compound and zeroed at the pole and equator. *Fig.* 7 shows this relationship. The stylus of the measuring device should have the same radius as the stylus of the tool cutting edge. Also, it must be able to operate within its accuracy tolerance when the sensitive axis is as much as 45 deg from the measured axis. This is necessary because, for radial parts, the sensitive axis will be normal to the surface of the part contour being measured at only one point as the lathe moves the measuring device from pole to equator.

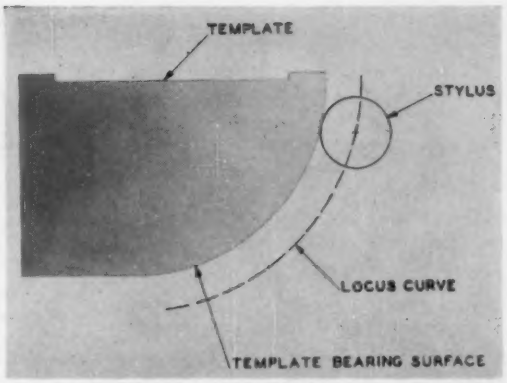


Fig. 5. Generation of locus curve as a ball-shaped stylus rides a template bearing surface.

If the error of the finished part is wholly from faulty lathe operation, the faulty lathe operation

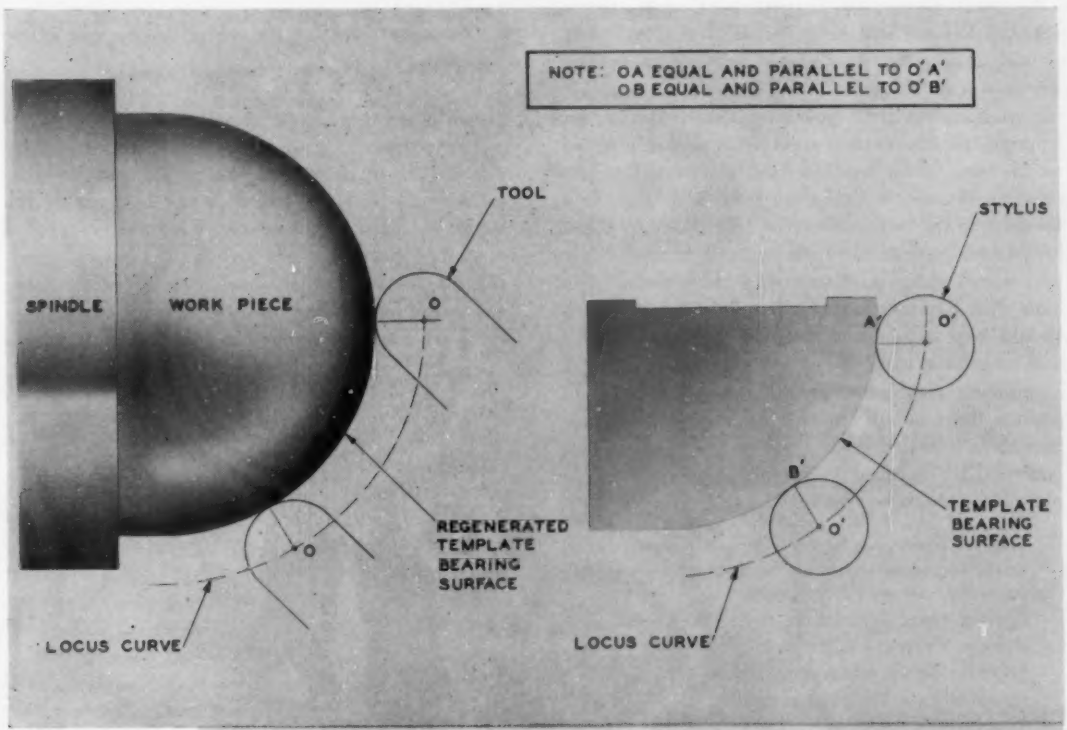


Fig. 6. Regeneration of template bearing surface path from locus curve.

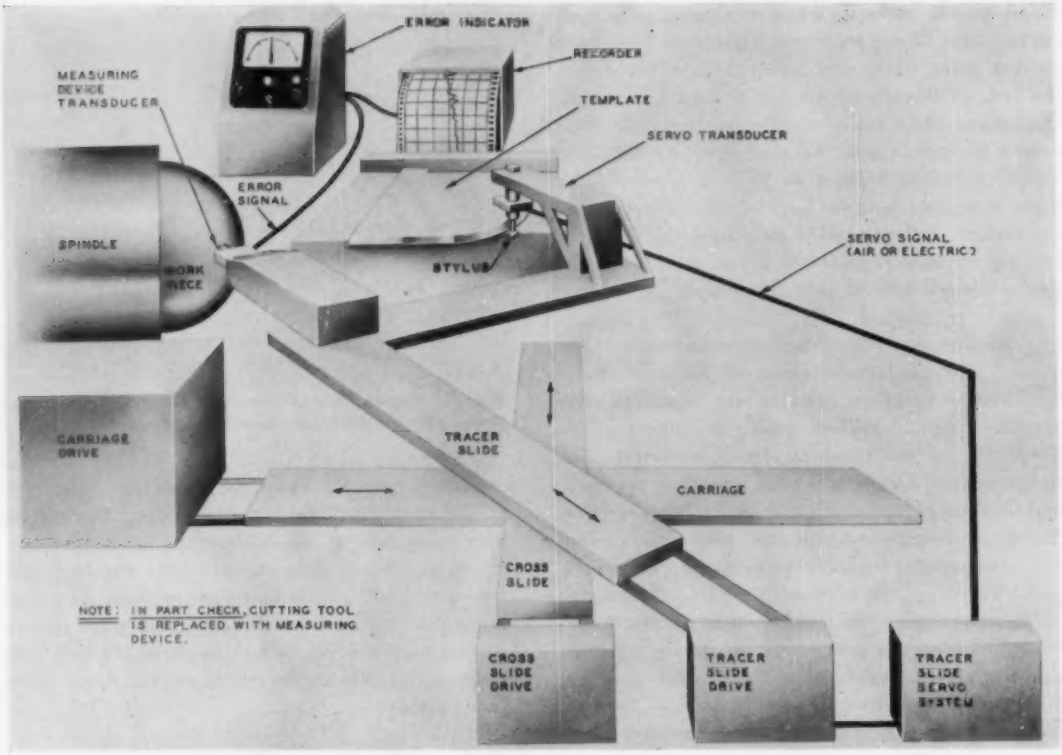


Fig. 7. Part check schematic. Cutting tool is replaced by a measuring device.

error movement will be repeated at the tool compound during the part check and the measuring device will shown no deviation from the zeroed reading as it moves from pole to equator. But if, for example, the tool cutting edge is not perfectly round or the tool thrust has distorted the part, the part check will show a deviation from zero that is a measure of the composite error. Because part check errors are composite, some will be compensative and some additive. Comparing the results of a male disk part check and a female disk part check should help to separate some of the compensative and additive errors. When the part check shows a significant machining error, it is necessary to analyze the non-lathe machining variables that are causing a transfer error between the no-load tool path and the finished part contour. The following outline summarizes these variables.

TOOLS: Finish and edge conditions, geometry, wear, height setting to centerline, angle of tool shank with respect to part, tool replacement.

CUTTING FORCE DEFLECTION: Boring bar displacement, shake in slides, cumulative machine deflection.

SPINDLE: Radial runout, axial slip.

CHUCK-TO-PART FIT: Sizing, contour.

TEMPERATURE EFFECTS: Template-to-part, part-to-chuck, machine geometry, measuring instruments.

ERROR IN PART MEASUREMENT GAGES: Diameter, wall thickness, depth, length.

SLIDE ADJUSTMENT: Equator adjustment, pole adjustment.

MATERIAL: Hard spots, stresses.

Operator error is another possibility.

If the total error of a machined part can be accounted for by the results of a part check, the error source will likely be found in one or more of the variables listed. If, however, the total error of a machined part does not appear in the part check results, it means that machining error is being caused by faulty lathe operation. Ways of checking lathe error will be covered in Part 2 of this article.

"Keep your eyes peeled for some designs we can "adapt!"

effects of

WORKPIECE DIAMETER ON TOOL LIFE

By **A. O. Schmidt**, Chief Engineer
J. R. Roubik, Senior Research Engineer
G. Hug, Research Engineer

Kearney & Trecker Corp.
Milwaukee, Wis.

RIGIDITY IS A FACTOR to be considered in any machining operation. In turning, for example, the ratio of the cube of the workpiece length to the fourth power of the diameter is a measure of relative rigidity between different pieces of the same material. This was apparent during a series of machining tests in which 47-inch-long SAE 4615 HR steel bars were turned, *Fig.* 1. With a 6.27-inch-diameter test bar, tool life was better than for a 2.5-inch-diameter bar of the same material cut under identical conditions. When the 2.5-inch-diameter test bar was shortened to 13.8 inches, giving about the same deflection under the cutting force as the 6.27-inch-diameter bar, tool life was approximately equal to that obtained with the larger-diameter workpiece. The dynamic stiffness of the smaller bar was greater than that of the larger bar. It is apparent that beam deflection of the workpiece may have to be considered when evaluating tool-life data for workpieces of various diameters.

This factor may help to explain why ceramic tools perform well when turning short, large-diameter workpieces. As the length of a workpiece in a lathe increases, the magnitude of deflection under cutting loads increases, as well as the associated chatter. The harder tool materials often are not able to tolerate the chatter.

From a paper presented at the ASTME Seminar "Metalcutting Today." Copies of the complete paper are available without charge from Society Headquarters.

A schematic diagram of the type of beam loading assumed to prevail in a lathe is shown in *Fig.* 2. This is a first approximation. According to standard reference works, the deflection for this type of loading is:

$$D_{max} = \left(\frac{7}{768}\right)\left(\frac{WL^3}{EI}\right)$$

where $I = d^4\pi/64$

From this it can be seen that in beam deflections the deflection effect varies as the fourth power of the diameter and inversely as the third power of length, i.e.,

$$D_{max} = \left(\frac{(7)\ (64)\ W}{768\pi\ E}\right)\left(\frac{L^3}{d^4}\right)$$

If a proportion is set up between two bars of different sizes but of the same material and having the same deflection under equal loads, the constants cancel out and the relation is:

$$\frac{L_1^3}{d_1^4} = \frac{L_2^3}{d_2^4}$$

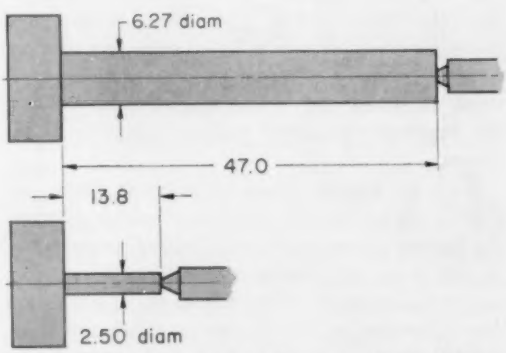


Fig. 1. It is necessary to shorten a 2.5-inch-diameter bar to 13.8 inches to obtain the same stiffness found in a 6.27-inch-diameter bar 47 inches long.

Nomenclature

D = maximum bending deflection of workpiece, inch
d = diameter of workpiece, inch
E = modulus of elasticity, psi
I = workpiece cross section moment of inertia, in-lb
L = length of workpiece between supports, inch
M_1 = reaction moment at fixed support, in-lb
R_1 = reaction force at fixed support (chuck), lb
R_2 = reaction force at simple support (tailstock center) lb
W = tool force, lb

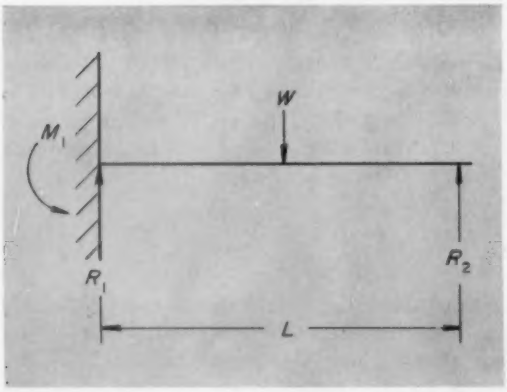


Fig. 2. Schematic diagram showing simplified assumed loading of a workpiece in a lathe.

Solving for L_2:

$$L_2^3 = \frac{L_1^3 \, d_2^4}{d_1^4}$$

$$L_2 = \sqrt[3]{\frac{(L_1)^3 \, (d_2)^4}{d_1^4}}$$

$$= \sqrt[3]{\frac{(47)^3 \, (2.5)^4}{(6.27)^4}}$$

$$= 13.8 \text{ inches}$$

In this case, an arbitrary value of 2.5 inches was used for d_2.

A test using the 6.27-inch-diameter, 47-inch long bar resulted in 0.010-inch flank wear on the tool after 56.6 minutes cutting time. With the 2.5-inch-diameter, 13.8-inch-long bar, 0.010-inch flank wear was reached in 60.5 minutes.

During these tests, all conditions except diameter and length were kept as constant as possible. The result indicates the effect of rigidity of the workpiece on tool life as expressed by the ratio L^3/d^4. The machine and setup were in such condition that no detrimental vibrations near the natural frequencies of the workpieces were introduced from the drive or the holding device—in this case a four-jawed chuck and a tailstock.

Diameter alone may have an effect on tool life, but the exact mechanics of this effect, if any, are unknown at the present time. It can be said, however, that when cutting bars of extremely different diameters with the same type of tool, the difference in tool life is due primarily to a difference in workpiece rigidity and not to a difference in diameter. If the workpiece diameter is considered in tool life tests, the length of the workpiece should also be taken into account.

Tester Diagnoses Missile Troubles

Predicting operational readiness of intercontinental ballistic missiles and other complex weapon systems is the function of an automatic electronic analyzer called D-PAT. A drum-programmed tester, the machine uses a digital computer with test program procedures stored on a magnetic memory drum to detect and isolate malfunctions down to the smallest replaceable unit or assembly of the system.

With its memory drum whirring at 2300 rpm, D-PAT clicks through a system checklist, confirming its own measurements with known values stored on the drum, and instantaneously starts exploring to investigate suspected trouble spots. If a malfunction is detected that could cause an unsafe condition, D-PAT declares an emergency and automatically shuts down the system.

Then, dipping into its library of 35-mm slides, D-PAT flashes repair instructions on a 15-inch view screen, displaying a picture of the circuit or assembly with a bright red arrow spotted over the component that is causing the trouble and needs replacing.

D-PAT will also predict the remaining useful life of a component by comparing its operation with its past performance and with the manufacturer's specifications. If the component appears to be breaking down, it can be replaced before it causes a system failure.

The basic difference between this tester, developed by Hughes Aircraft Co., and other automatic testers is its digital computer. It is a smaller offspring of the Hughes' Digitair airborne computer.

D-PAT will test any electronic system anywhere, whether at the ICBM launching site, in the control center of a fleet at sea or behind the battle line.

techniques of
ULTRASONIC MACHINING

By Aaron L. Roses
Tool Designer
Truare Retaining Rings Div.
Waldes Kohinoor, Inc.
Long Island City, N. Y.

Fig. 1. Tooling setup for machining a ferrite rotor ultrasonically. An indexing fixture is used.

In a practical guide to the use and application of ultrasonics in precision tooling, the author explains how ultrasonic machines work, what they can accomplish and how to select tools, toolholders and abrasives.

IN LESS THAN TEN YEARS, ultrasonic machining has advanced from an experimental process to one with a wide range of practical applications. Through the use of ultrasonics, materials formerly considered beyond the realm of practical machining now are cut, shaped and formed quickly and inexpensively on a production-line basis, *Fig.* 1. Tungsten carbide, hardened tool steels, quartz, ceramics, glass, germanium and many of the superalloys are being utilized for a variety of military and civilian applications. Before the advent of ultrasonic machining, these materials either were impractical or economically unfeasible to machine.

One of the most widely adopted applications of ultrasonics has been the machining of intricate shapes in carbide dies. Because carbide dies are normally made in sections, they require highly skilled toolmakers, and expensive tooling and machining operations. With ultrasonics, a soft or semihard tool steel—machined to the shape desired—is used to cut into a solid block of carbide, eliminating the need for separate precision-made sections. A semiskilled operator can handle the job easily, and expensive tools and machining operations are unnecessary.

Because America's role in the world-wide competition for technical supremacy depends in large measure upon the advancement of our manufacturing methods, it is important for designers, tool engineers and production executives to become familiar with all of the techniques and processes available for precision tooling and other machining operations. It is even more important that they learn to use these techniques and processes efficiently and economically. For this reason, a review of the basic techniques of ultrasonic machining—in-

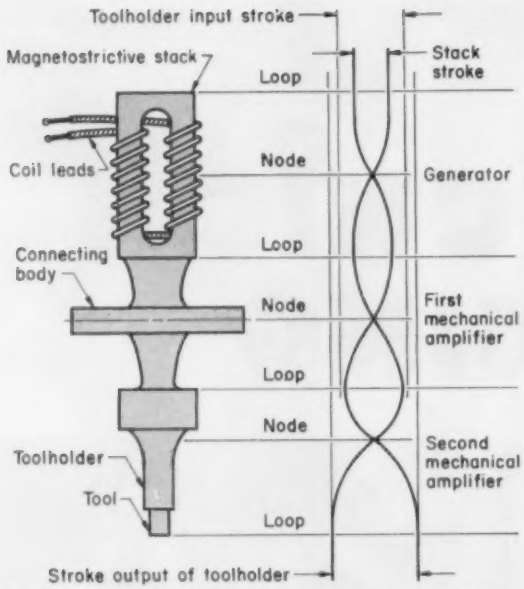


Fig. 2. Electrical energy is converted to high-frequency mechanical energy in the magnetostrictive stack at top, then transmitted to the tool through the connecting body and toolholder.

cluding the practical aspects of tool design, toolholder selection, and the selection of abrasives—may be of value to manufacturing engineers.

How It Works: In ultrasonic impact grinding or machining, the process invented by Dr. Louis Balamuth in 1952, ultrasonic waves or vibrations are converted by means of a magnetostrictive transducer into mechanical vibrations. Attached to the transducer are a toolholder and tool for cutting any desired shape. As the tool vibrates at a high frequency and low amplitude in the work, a mixture of abrasive, suspended in water, is allowed to flow over the workpiece. The combination of ultrasonic vibrations and abrasive slurry cause literally thousands of microscopic abrasive particles to sink, engrave or other wise form precision shapes in hard and brittle materials. The depth of machining and shape of contour can be controlled to within 0.0002 inch, depending upon the size of the abrasive grit and finishing tools used. Because heat is not generated in ultrasonic machining, as it is in conventional grinding operations, materials can be machined without fear of grain structure changes that would affect strength.

The Transducer: The heart of any ultrasonic machine is the transducer. This device is used to convert electrical input energy into mechanical output energy in the form of high-frequency vibrations.

Various types of transducers are available for use in ultrasonic equipment. Among the most widely used are the magnetostrictive and the piezoelectric types. The magnetostrictive transducer usually is preferred for ultrasonic machining purposes because of its ability to operate at full power for extended periods. Piezoelectric transducers, usually made of either ceramic or natural crystals such as quartz, generally are used for low-power applications such as nondestructive testing machines and ultrasonic cleaning equipment.

A typical magetostrictive transducer is shown schematically in *Fig.* 2. It has three major components—a stack, a connecting body and a toolholder. As its name suggests, the transducer functions by providing a magnetostrictive effect—i.e., it utilizes

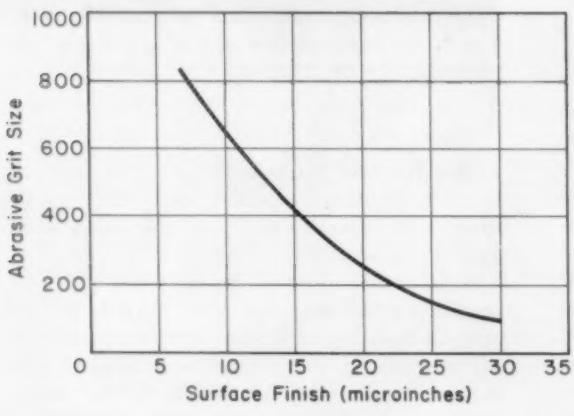


Fig. 3. (above) Relationship between abrasive grit size and surface finish. Smallest particles produce the best finishes. Largest particles cut fastest.

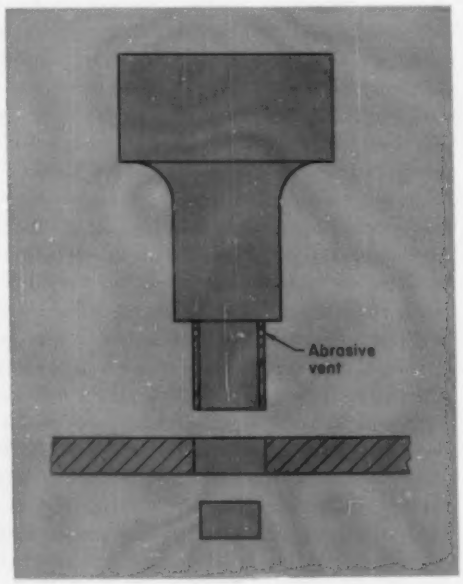


Fig. 4. (right) Tubular trepanning tool for ultrasonically machining through holes. Vents allow abrasive flow.

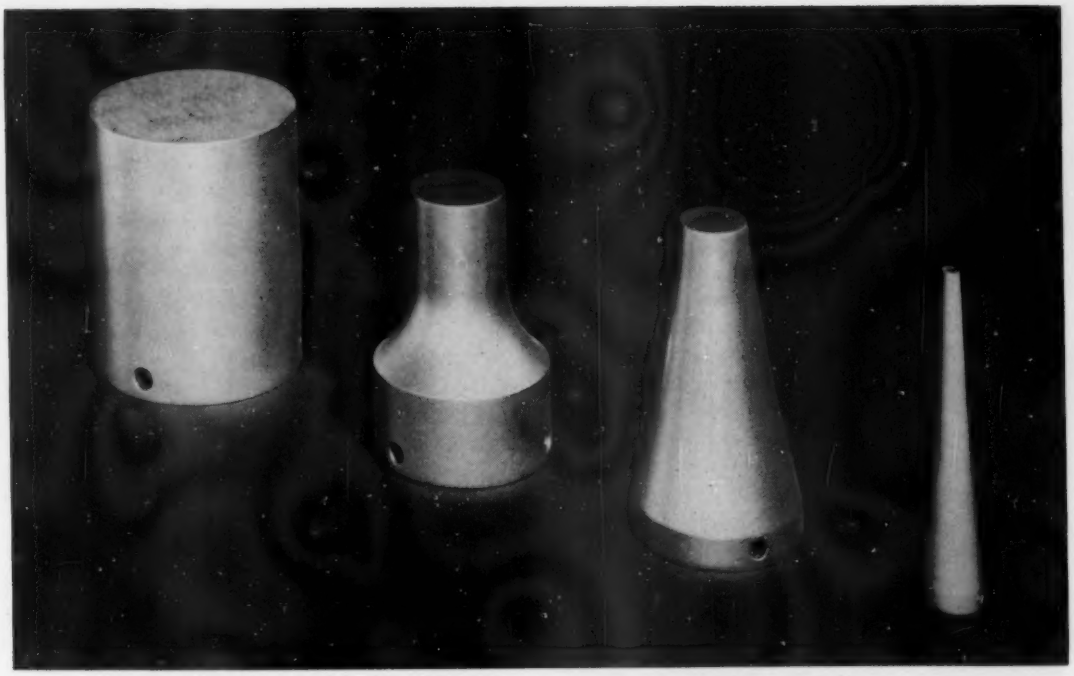


Fig. 5. Ultrasonic toolholders. Tapered styles are for machining small areas.

a change in length of ferromagnetic materials placed in an alternating magnetic field. Nickel is one of the best commercial elements used for this purpose and is preferred because it can withstand the high internal stresses encountered in ultrasonic applications.

In the transducer illustrated, the magnetostrictive stack is made of a quantity of nickel laminations around which is wound a coil of insulated wire. Minute length changes take place when the stack is placed in an alternating magnetic field. Attached to the stack is the connecting body which receives, transmits and amplifies the length changes. It also serves to support the entire system. The third element is the toolholder, which transmits and further amplifies the stroke at the tip of the cutting tool. This completes the basic system.

Abrasives: The cutting agent used for ultrasonic machining is a mixture of water and abrasive of one of the following types: boron carbide, silicon carbide or aluminum oxide. During the machining operation, the abrasive is transported between the tool and the part being produced. The cutting action takes place while the tool is vibrating at a high frequency in the workpiece.

To obtain the desired action, it is necessary to choose the abrasive carefully for the individual job requirements. Factors which determine the selection of proper abrasives for ultrasonic machining are essentially the same as those governing the choice of grinding wheels for conventional grinding operations. These include the kind of material to be machined, the hardness of the material, the amount of stock to be removed and the finish.

Boron carbide is the most widely used abrasive, because of its hardness and resistance to fracture. It will cut at a faster rate than the other abrasives mentioned and also has the ability to withstand the tremendous vibrational and impact forces encountered in ultrasonic machining, without fast breakdown. This is important when work is being held to very close tolerances.

The softer abrasives cut more slowly, thus increasing machining time. The softer abrasive grains also tend to wear rapidly, with the result that accuracy is more difficult to maintain without frequent abrasive replacement.

Particle size has a direct effect upon abrasive cutting action. The particle sizes of abrasives commonly used in ultrasonic machining are listed in TABLE 1. The coarser grit sizes—i.e., 240 through 320—are used for roughing, while the finer sizes are employed for finishing to varying degrees of smoothness. Surface finishes produced will range from approximately 30 to 6 microinches. Control of surface finish by the selection of various abrasive grit sizes is charted in *Fig.* 3.

Tool Design: An obvious advantage of the ultrasonic machining process is the simplicity of tools required to shape complex cavities. The shape

and dimensions of the part to be produced will be determined by the shape and dimensions of the tool that is used.

In designing tools for ultrasonic machining, the designer should bear in mind that the tool is an important element in the ultrasonic system and as such is subject to the ultrasonic vibrations and the stresses incurred.

The first consideration should be the selection of a suitable steel. Materials that give satisfactory results are the alloyed steels or stainless steel grades. Brittle or hard materials such as carbide and hardened tool steels cannot be used satisfactory because they cannot endure the tremendous internal stresses to which ultrasonic tools are subjected. Ductile materials such as copper, brass and aluminum also are unsatisfactory since they tend to wear excessively.

A second consideration is the contact area of the tool. A tool with a small contact area will penetrate the workpiece more rapidly than a solid tool. For example, when machining a through hole it is advisable to use a tubular type trepanning tool such as the one illustrated in *Fig.* 4, rather than a solid tool.

The over-all length of the tool is a third consideration. The normal maximum tool length is 1.5 inch, although lengths up to 6 inches can be used. In order to determine the proper tool length required for a particular job, the tool's cross-sectional area should be matched with a length suitable to the resonant frequency of the toolholder. The manufacturer's recommendations should be followed in this procedure.

Fig. 5 illustrates several toolholders designed for ultrasonic machining purposes. The first two are cylindrical in shape and are used for large cutting areas; the tapered-cone-shaped tools, also known as "exponential" types, are for use where small areas are to be machined.

In some cases it may be necessary to use a tool with a very small cross-section. In such instances, the tool must be made considerably smaller than 1.5 inch and yet cut efficiently.

Figs. 1, 6 and 7 show the tooling operation for a ferrite rotor in which the slots are machined to a width of 0.113 ± 0.0005 inch and a depth of 0.030 ± 0.0005 inch.

Fig. 1 illustrates the tooling setup as it was handled on a 1000-watt ultrasonic machine tool. Note the simplicity of the tool used for the machining operation. A close-up of the slotted tool and the finished parts is shown in *Fig.* 6. The tool is brazed to the toolholder.

The configuration of the finished part is shown enlarged on a comparator in *Fig.* 7. The sharp and chip-free edges obtained with the utrasonic process are clearly seen.

Fig. 6. Ultrasonic slotting tool and finished ferrite parts.

Machining Rates: The cutting rates achieved by ultrasonic machining are determined by many factors, each of which is important and must be

Table 1—Average Grain Size

Grit Size	Particle Size Inch	Micron
180	0.0034	86
220	0.0026	66
240	0.00248	63
280	0.00175	44
320	0.00128	32
400	0.00090	23
500	0.00065	16
600	0.00033	8
800	0.00028	7
900	0.00024	6

Table 2—Cutting Rates

Material Machined	Machining Rate (cu. in./min)
Carbon	0.030
Glass	0.016
Ceramics	0.010
Silicon	0.010
Germanium	0.010
Quartz (crystal)	0.007
Garnet	0.008
Ferrite	0.018
Carbide	0.0003
Tool Steel (hardened)	0.00017

Fig. 7. Finished part enlarged on comparator. Edges are sharp and chip-free.

taken into consideration. These include:

1. STROKE AMPLITUDE: A stroke of 0.002 inch has more driving force and cuts faster than a 0.0005-inch stroke. In many cases the application determines the stroke amplitude. A delicate tool shape cannot withstand high-amplitude forces.
2. ABRASIVE SIZE: Coarser grits will cut faster than fine grit. Finish requirements for the workpiece will determine the abrasive required.
3. ABRASIVE TYPE: Boron carbide, the hardest of the available commercial abrasives, is more efficient and durable than silicon carbide and has been found to give good results on a large variety of materials.
4. ABRASIVE CONDITION: New abrasive, having sharp edges and points, will chip away the workpiece material faster than abrasive which has been dulled by long periods of time. Abrasive which has been contaminated excessively by other materials will not cut efficiently.
5. PERCENT OF ABRASIVE (by volume mixed with water): A weak solution (10 percent) has very little cutting ability compared with a solution strength of 50 percent. The following strength mixtures are suggested for general machining purposes: No. 240—55-60 percent abrasive by volume; No. 400—45-50 percent abrasive by volume; No. 800—35-40 percent abrasive by volume.
6. AREA OF STOCK REMOVAL: The greater the mass to be machined the slower the cut. Tools should have the least amount of area contact possible. If a 0.500-inch diameter hole is to be machined through a part, a thin-wall tube should be used rather than a solid rod. The end result will be the same in much less machining time.
7. WORKPIECE MATERIAL HARDNESS: The minimum practical hardness for steel is 55 Rc. Density is another factor to consider, especially in ceramics where a great many types are available. Another factor is brittleness, since the ability of material to fracture under impact is one of the most important requirements for efficient machining.
8. CONTROL OF TOOL FEED: The tool can be overfed (too much pressure) causing a jamming condition, or underfed where the tool is not keeping up with its potential cutting ability. Either condition will restrict the cutting action.

Average cutting rates for materials frequently machined with ultrasonic equipment are listed in TABLE 2. Because cutting rates are dependent upon all of the factors described above—and upon individual job requirements—the figures given are not to be construed as absolute values. Faster or slower rates can be attained under varying conditions. The figures can be used, however, as a general guide for the materials listed.

Note: The author is indebted to the following companies for their valuable assistance in the preparation of this article: Cavitron Corp., Long Island City, N. Y., Norton Co., Worcester, Mass., Raytheon Co., Norwood, Mass., Sheffield Corp., Dayton, Ohio.

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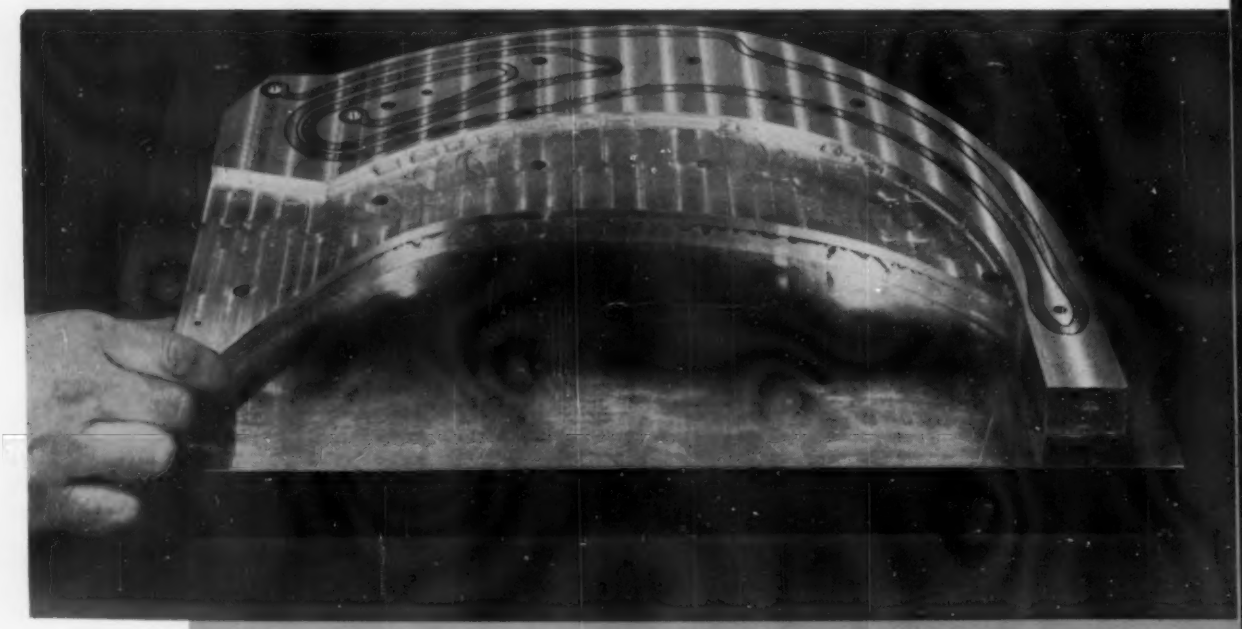
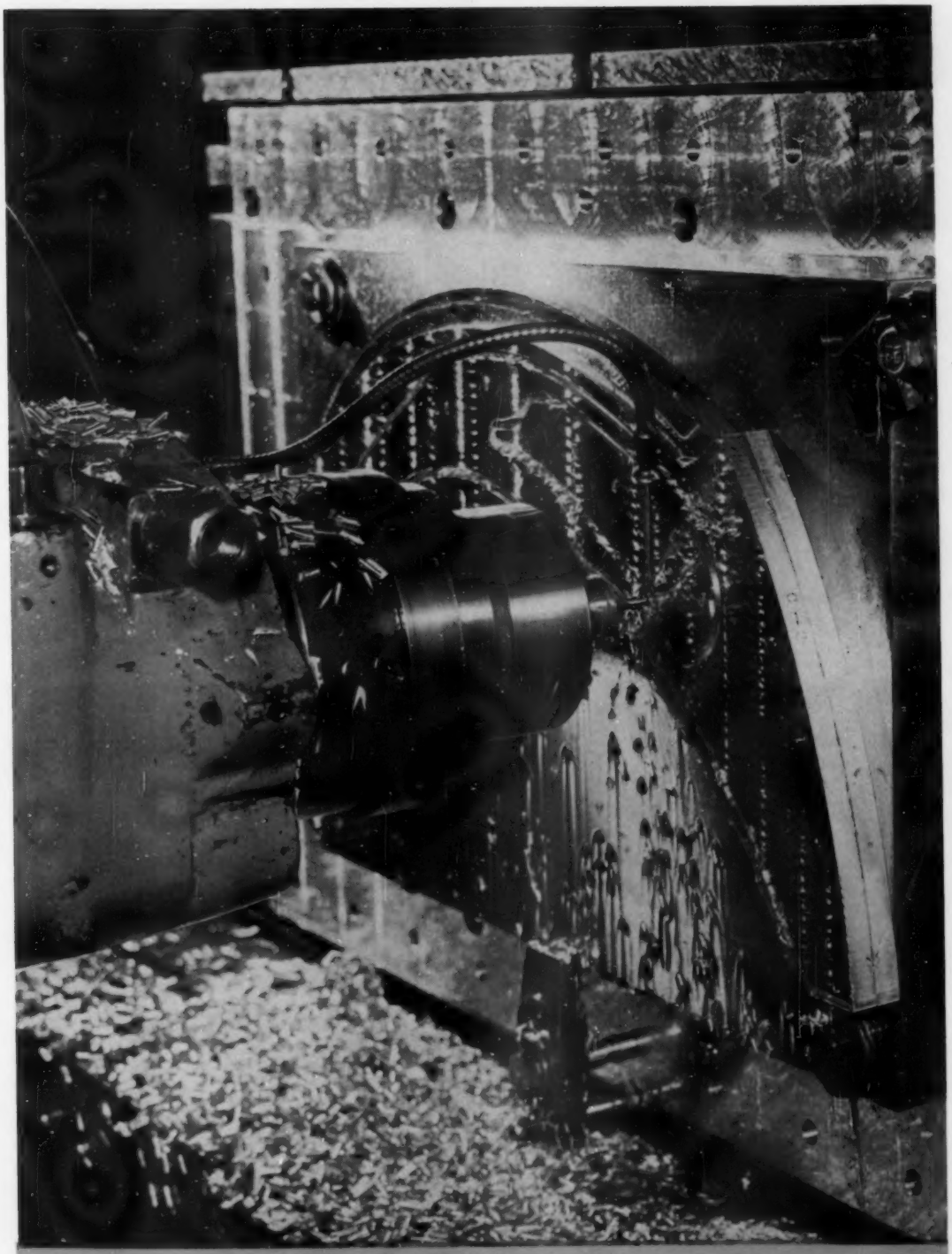
TOOLS at work

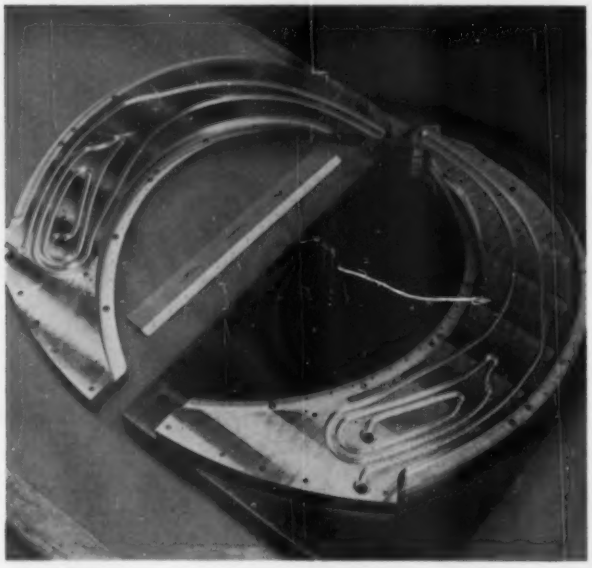
For production of a cyclotron model, engineers at Oak Ridge National Laboratory (operated by Union Carbide Corp. for the AEC), turned to computer programs and numerical control. The computer program determines the shape of a coil needed to attain desired magnetic field characteristics. From this information, another computer produces tapes to machine analog sectors under numerical control. Advantages of numerical control are the short lead time, high repeatability accuracy, and the fact that the sector plates very likely could not have been manufactured by any other means. Core of the workpiece is a piece of copper that conducts current to create a precisely shaped magnetic field. The copper is held in matching grooves machined in aluminum plates. Processing, tape preparation, machining and assembly of this complex and precise nuclear workpiece was done by manufacturing engineers at the Industrial Controls Section of The Bendix Corp.



COMPLETED PROTOTYPE of an analog sector plate, made to determine manufacturing feasibility. This test workpiece was subjected to the loads and conditions that will be encountered in the working model cyclotron to verify that the manufacturing method used was adequate. The copper inlay is machined with a 0.002-inch edge clearance. Spillover of epoxy bonding the plates is machined off in later designs.

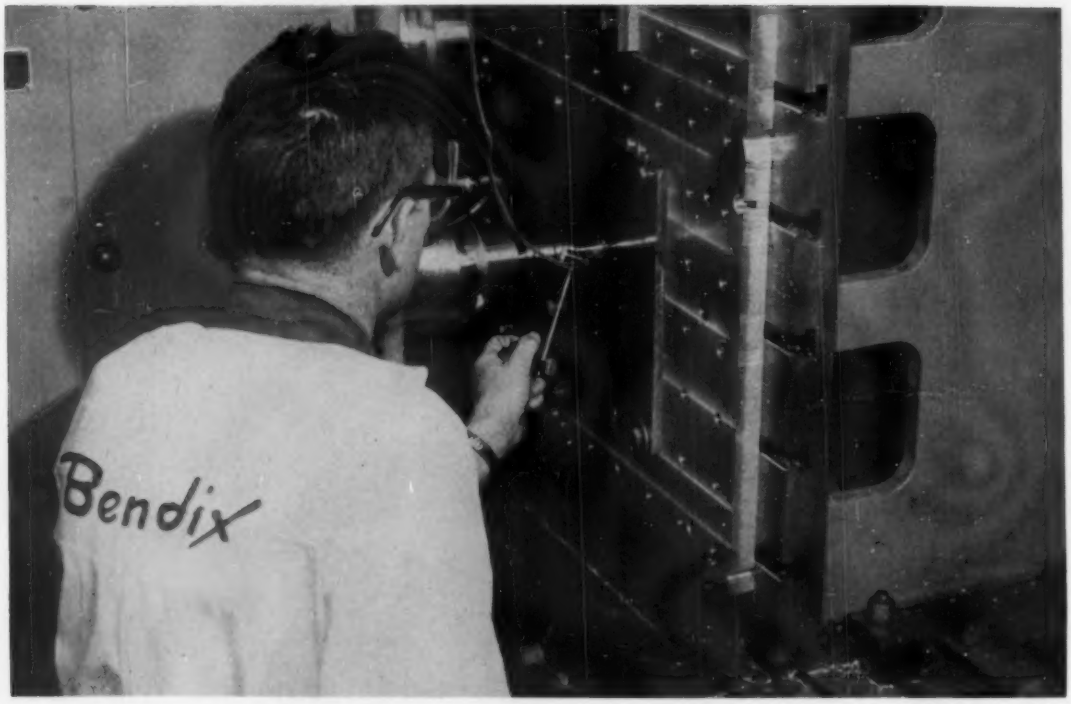


FIRST PASS on the conductor groove, made with a 0.250-inch end mill ground 0.002 inch undersize. Succeeding passes finish the groove to exactly 0.250-inch width, with a 25-micro-inch surface finish. At this phase, the workpiece consists of two epoxy-bonded plates of aluminum and already has water grooves contoured in it. The workpiece is held by bolting it to flatness specifications from the underside of the precision-ground steel plate.



MATCHED left and right-hand pair of sector plates, ready to receive copper conductor into the grooves machined in their upper surfaces. After the copper is epoxy-bonded in the grooves, the surface is given a final face mill pass to 0.0002-inch tolerance, using a special ground flycutter to cut the three dissimilar materials (copper, epoxy and aluminum). About 30 hours' machining time is required for each of the sixteen sector plate assemblies being made. Final operation will be the assembly of the sector plates into the operating model of the cyclotron. Trimmer coils will be mounted on the shouldered surfaces, to bring the magnetic field into the exact adjustment required for accelerating electrons through the analog model of the cyclotron.

TOOLS at work



COPPER PLATE is set up on a three-spindle Numeric-Keller for spotting and drilling the locating holes prior to milling. The copper conductor form is produced by contour milling after the plate has been faced to 0.0003 inch. Profiling the shape requires five passes using a 0.125-inch-diameter cutter. Three passes are required to achieve the depth of cut needed without overloading the cutter, then one pass for the contour and the fifth pass is a spring cut pass.

Large airy chamber, tunneled from solid rock, is typical of the underground plant.

PLANT DIGS IN —costs descend

By building its plant underground, Brunson Instrument Co. has proved that underground plants cost less to build and maintain than above-ground plants. An added advantage for precision work is the ease with which the environment is controlled.

By Robert Heslen
Associate Editor

PERHAPS 50 MILLION YEARS AGO, man first started to manufacture crude implements from chipped flint, very likely in the shelter of caves. Since then, most manufacturing activity has been done above ground. But at least one company in this country has constructed an underground plant.

The decision to move below ground was made about ten years ago and was influenced by government bulletins on underground factories and by European experience in constructing and operating such factories during the second World War. After conception of the idea, there was some weighing of the pros and cons, and for instrument manufacturing, requiring a stable clean environment, the pros won. Selection and acquisition of a suitable site was then studied. Several quarried and natural caves in the region were investigated, and rejected for various reasons. Finally, a limestone quarry was selected and after preliminary design studies, tunnels were blasted out of the limestone. Large, airy chambers resulted. As tunneling proceeded, the limestone removed was crushed and sold to help defray the cost of plant construction.

Basically, the plant consists of six tunnels 30 ft wide and 525 ft long. The tunnels run east and west and are on 45-ft centers. Intersecting north-south tunnels are spaced at approximately 90-ft in-

tervals. Ceiling height, before the concrete floor was laid, was 12 ft. Over 140,000 sq ft of usable floor area resulted from hollowing out the limestone. Walls were painted with a white sealer, and the concrete floors sealed to prevent dusting. The move into the plant began about a year ago and is now approximately complete. During this experience of one year's operation underground, all the advantages anticipated and designed into the plant have improved productivity and quality of production. Moreover, the plant turned out to be less costly to build and operate than above-ground plants. Because the digging cost was largely paid for by selling quarried limestone, the underground factory cost roughly one-third as much as equivalent above-ground space. The plant is almost entirely free of outside environmental influence. The cost of heating and air conditioning is roughly one-third that of a surface plant. Average wall temperature of the limestone at the time the plant was being completed was 54 F. Thus, the air-conditioning operation is primarily concerned with humidity control. Based on wall-temperature data collected to date, it is presently anticipated that in three years the wall temperature will be sufficiently high that radiant heat from light bulbs, motors, personnel and so forth, will keep the temperature at the desired level, and no additional heat input will be required.

Heat is used for dehumidification. In this system, air from the plant or brought in from the outside is chilled to about 50 F to remove moisture and then brought back up to temperature. Under present conditions of wall temperature in the plant, the per-month heat costs have averaged $170 over a 13-month period. It is anticipated that the 50-ton air conditioner will run about 120 days a year. Temperature has remained within a 2-degree spread and humidity has remained at 50 percent or less.

The result is an extremely stable environment. Catastrophic failure of the heating equipment would not be immediately noticed. Thus, there is little thermal variation of stock, machines or environment in the plant. By this means, the plant minimizes undesirable thermal effects on instrument accuracy. Because the walls, ceiling and floors are dust sealed, and because the plant is not exposed to an outside dusty environment, degradation of instrument accuracy from dirt sources is minimized. In many ways, the underground plant naturally resembles the "white" plants and laboratories developed in above-ground facilities for precision transistor, electronic and instrument work. Being bedded on solid rock, all machine foundations are firm and there is little tendency for vibration of one machine to impair accuracy of another machine.

Workers seem to enjoy the underground environment. Temperature and conditions are uniform everywhere. There are no local hot or cold spots caused by the hot afternoon sun or windy, drafty corners. This has contributed favorably to productivity. Also, the ample space available has contributed to productivity. The plant is free from surface noises. In general, most employees seem to find working conditions pleasanter in the underground plant than in surface plants in which they had previously worked. Within the plant, fire protection is fairly well assured by the type of construction. Protection from Kansas cyclones is much greater than in surface type constructions. There is nowhere less than 45 ft of limestone, shale and soil overburden between the plant ceiling and the surface. All plant entrances are protected from blast waves by architectural and natural construction. Civil Defense authorities estimate that anything short of a direct hit by a hydrogen bomb would affect the plant very little.

In general, the advantages of the underground plant are its low initial and operating costs, and the fact that the clean, stable and solid environment enables greater accuracy of the machines and tools than is possible in an above-ground plant. These obvious advantages, plus the protection against fire, cyclone and possible bomb damage are causing the underground plants to receive serious consideration. Already, in this area, the natural seams of Bethany Falls limestone are being quarried with care, so that the resulting void can serve as plant space. Both warehousing and manufacturing operations are being set up in such underground plants. Although development of one underground pant does not yet indicate a trend, it does indicate practicality and feasibility.

"I know the rickety thing's running normal! but can't you do something about it?"

producing POWDER METALLURGY PARTS

By P. V. Schneider
Advisory Metallurgist
Development Laboratory
General Products Div.
International Business Machine Corp.
Endicott, N. Y.

Major savings can be realized when powder metallurgy techniques are used to produce small, complex parts. The author shows how parts are designed with powder metallurgy production in mind and explains special tooling.

Fig. 1. This part was produced as a three-piece assembly from wrought components; with powder metallurgy fabrication, it is produced in one piece.

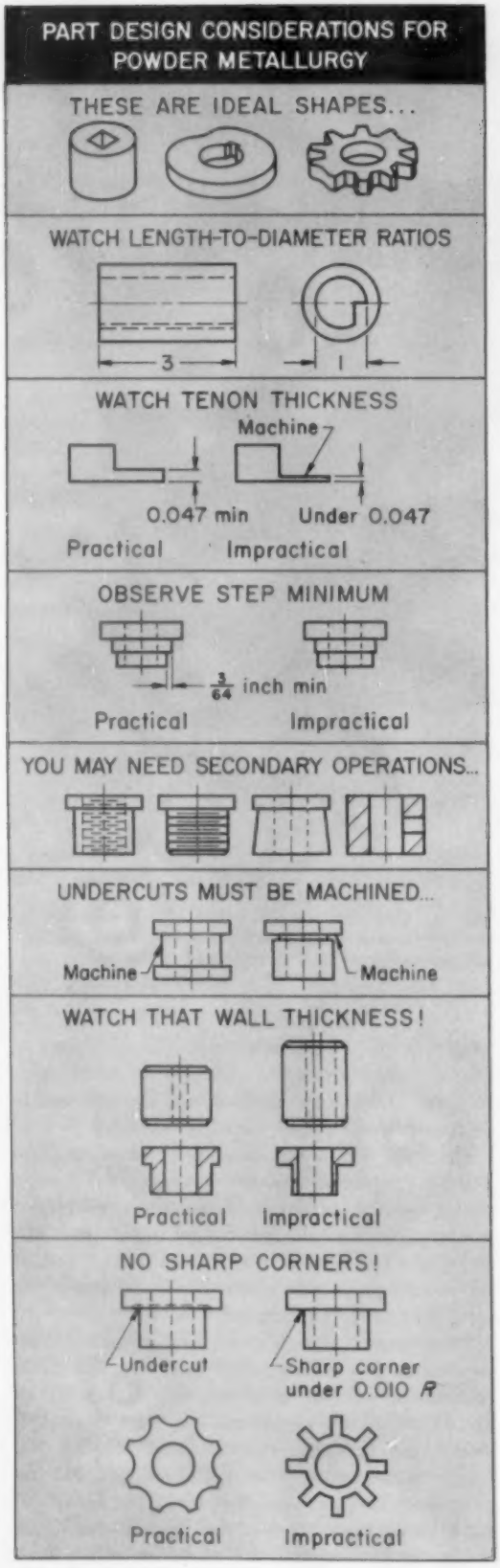
WITH THE NEED for lower costs and shorter lead times, the powder metallurgy process is coming into its own. The development of improved presses and advances in processing techniques have enabled higher part densities—hence stronger parts—to be obtained, and refinements in precision tooling materials and equipment now make possible the production of a wide range of high quality parts. Further, some parts—complex cutting tools, filters and electrical contacts—cannot be economically fabricated by any other process. Sometimes assemblies can be produced as one piece, *Fig.* 1.

Cost Savings

The savings that are possible by changing to powder metallurgy production are illustrated by fabrication of a hinge cam, *Fig.* 2. Originally, this part was of wrought material. The operations involved were blanking, grinding both sides, drilling, reaming and countersinking several holes, milling and burring the slot, and boring and ball-sizing several 0.500-inch diameter holes. In all, a total of 14 fabrication operations and 10 setup and inspection operations were required, and the part had to be transported 16 times during processing.

The same part is now produced from a medium-density iron-copper powder. Only six fabrication operations and four setup and inspection operations are required, and the number of in-process transportations has been reduced to eight. Unit cost of the powder metal part is about half the cost of the same part produced from solid stock.

Even greater savings have been possible in the production of a ratchet gear, *Fig.* 1. Originally this part was an assembly consisting of a ratchet, a gear and a bushing. The ratchet and gear were assembled, staked and hydrogen brazed. After brazing, the copper was stripped from the brazed unit and the parts were hardened and tempered. The ID of the ratchet-gear assembly was then ground for press fitting the bushing into the assembly. After press



fitting, the bushing ID was ground.

Some 29 fabrication operations and 22 setup and inspection operations were required to produce the complete assembly from wrought parts. The same part is now being produced in one piece by powder metallurgy techniques. Only 14 fabrication operations and 7 inspection and setup operations are required. The cost is about one-quarter the cost of producing the three-piece assembly.

Part Design

Successful production of high quality, low cost parts from metal powders depends to a great extent on the part design. As a general rule, parts should be designed specifically for fabrication by powder metallurgy, rather than be adaptations of designs originally intended for production by other methods.

The powder metallurgy process has several distinctive features that must be considered during part design. The limited flow of metal powder in the die requires that the designer plan surfaces and contours that can be produced with vertical compression by top and bottom die motions. Compression from both the top and bottom of the die is essential to insure uniform powder metal distribution and density throughout all sections of the part during briquetting.

A wide range of shapes can be produced by powder metallurgy. Involute gears, costly to produce by conventional machining, can be economically fabricated by powder metallurgy. Parts with irregularly shaped holes, keyways, eccentrics, splines and counterbores also lend themselves to power metallurgy production.

Some ideal part shapes for powder metallurgy production are shown in the accompanying chart. Parts with rounded edges are more practical than parts with sharp edges. Deep and narrow splines are difficult to mold because of the lack of powder flow in the die, so they should be avoided.

Often minor modifications in a part make production by powder metallurgy techniques feasible. Parts designed with conventional molding and machining in mind may have sharp edges, close tolerances and complex curvatures. Many of these designs could easily be modified to permit satisfactory fabrication by powder metallurgy.

For example, a 0.002-0.003-inch break might be specified for the tip (point of intersection on the OD) of a ratchet tooth, gear or latch. Satisfactory performance might be possible with a 0.010-inch maximum break. Increasing the tip dimension in this way would permit successful fabrication by powder metallurgy. The larger break would allow better control of the powder density in the tip area.

Powder metallurgy parts are briquetted in an axial direction. Normally, the length-to-diameter

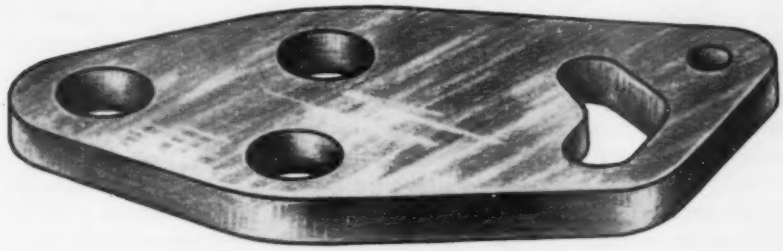


Fig. 2. When produced from wrought material, this part required a long series of precision machining operations. When produced by powder metallurgy techniques, the holes and slots are produced by the die.

ratio should not exceed 3:1 for iron-base materials and 4:1 for copper-base materials. The ratio sometimes varies slightly depending on the method used to mold the part. It is important to maintain the correct ratio, however, where high and uniform density is essential to the part application. Densities can be closely controlled if compression is the same from both the top and the bottom of the die.

Maintaining normal length-to-diameter ratios is particularly important in the design of parts that are to be heat treated. Such parts must have uniform densities throughout in order to control hardness, carbon penetration and dimensional stability. The normal ratio should also be maintained in the design of long bearings or feed rolls, which require uniform density to insure proper lubricant feeding.

In some cases, tolerance requirements may make it necessary to fabricate powder metal parts in sections, which are then joined by press fitting or brazing. This is true of long bearings.

Parts should be designed with uniform cross sections to avoid undesirable density variations. Parts with several steps or double-hubbed sections usually require secondary machining operations, which add to the unit cost. Low and medium density parts can be fabricated with longer tenons on opposite sides of the part by transfer of metal powder from the bottom punch to the top punch during compression. With high-density parts, however, tenons limit the amount of metal powder transfer, increase tool wear and result in undesirable density variations due to the limited powder flow.

Wide variations in the thickness of multiple step parts may cause severe stresses in the die, thus limiting die life. Dimensional control is difficult and distortion of the part during sintering is inevitable. Secondary machining is generally required.

Production of multiple step parts requires individual punches for density control and for ejecting the part from the die. The type of press employed usually determines the complexity of the tools required for making several part steps. If the punch motions are available with the press, less expensive tools are required, while with a simple press it may be necessary to build the motions into the die set, which adds to tool costs.

For ease of ejection from the die, each step of cylindrical shapes having multiple step configurations should be a minimum of $\frac{1}{64}$-inch larger per side than the preceding step. If the design is such that sleeve punches must be utilized for ejection from the die, a minimum step of $\frac{3}{64}$ inch per side is recommended to facilitate ejection. Positive ejection of each step is normally needed for high density stepped parts; comparable low and medium density parts do not often present ejection problems.

When parts have two or more steps, upward movement of the lower punch is required to firmly support the part during ejection from the top of the die. Some presses are designed so that the bottom punches remain stationary during compression as the die moves downward and ejects the part from the top of the die. Each ejection method has its

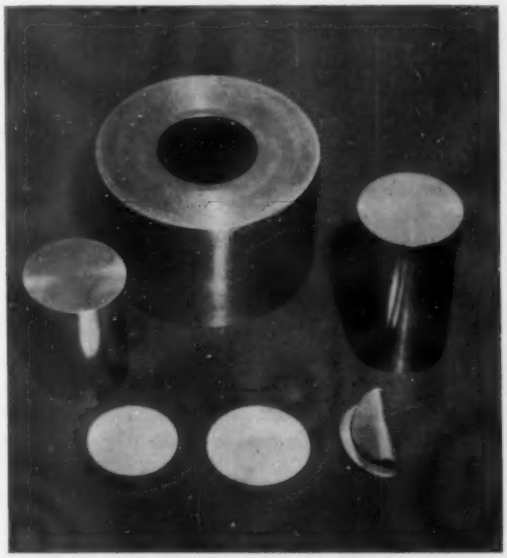


Fig. 3. Prototype tooling for producing a small filter. Punches do not have shoulders. Tooling is used in simple platen press.

merits. The higher the part density, however, the more important is positive support by the lower punch during ejection.

External and internal threads cannot be molded; they must be produced by secondary operations. For internal threads, a hole through the part or a counterbore for a blind hole can be provided during the pressing operation. The holes can be tapped in a secondary machining operation.

It is not practical, from a production tooling standpoint, to fabricate parts with re-entrant angles and holes at right angles to the axial pressing direction using powder metallurgy techniques. A few parts with re-entrant angles and side holes have been fabricated by employing movable side punches. Success with such configurations has been limited to short runs. Precise filling of the mold with powder and uniform timing of the moving side punches is essential.

Powder Metallurgy Tolerances

Dimension	Tolerance (inch)
Concentricity (TIR)	0.003
Distance between holes, inch (⅛-inch minimum)	0.0015
Thickness parallel to axis of compression	
up to 0.125	±0.0015
0.125 - 0.375	±0.002
0.375 - 0.625	±0.003
0.625 - 1.000	±0.004
1.000 - up	±0.005
Radial dimensions	±0.001
Peripheral dimensions or radial locations	±0.0005
Parallelism to datum	±0.0005

Undercuts, both internal and external, that form angles to the direction of pressing require secondary machining operations. Abrupt changes in wall thickness, or thin walls, create briquetting difficulties in fabricating powder metal parts, due to nonuniform powder fill in the mold and unequal expansion after ejection from the mold. With such parts, dimensional control problems may arise during sintering operations as well. Although it is not possible to specify wall thickness minimums here, due to variables such as part size, density, configuration, pressing tonnage and so on, wall thickness should be sufficient to avoid ejection troubles during production.

Sharp corners are not practical for powder metal parts, since stress concentrations forming at the junction of steps can cause early part fracture. For workable part design, fillets or corner breaks of 0.010 to 0.015 inch are recommended. In part designs where a sharp corner is necessary, an undercut can be utilized to produce a practical part.

Tools and Tooling

Tooling considerations are different for parts in each density range—low, medium and high. Normally the lower density parts require fewer processing operations. They have comparatively low metallurgical and physical properties. Because briquetting pressures are low, low-cost tooling can be used. Parts requiring oil-less lubrication and filtering qualities are typical low-density applications.

Structural machine parts—gears, cams, ratchets, levers, pawls—are ordinarily fabricated in the medium-density range. A number of these parts have also been produced utilizing high-density materials, replacing parts of wrought metal. High-density parts can be produced with tensile strengths of over 150,000 psi and hardnesses of R_c 60. The parts can be through-hardened or hardened so as to leave a soft core.

The feasibility of producing a part by powder metallurgy techniques depends on the pressing and sintering equipment available and the type of tooling needed, as well as the part design. Pressing tonnage is a direct function of part area and density so parts with large areas and high densities must be produced on high-tonnage presses. The length of the part determines the length of the powder fill in the die. The fill-length to part-length ratio is usually from 2:1 to 3:1. A part three inches long would thus require a metal powder fill from six to nine inches long.

The need for complex tooling sometimes limits the number of levels, holes and so on that can be briquetted. The part designer and tool designer should work together to achieve the simplest and most practical tooling possible. In some applications it is best to form the basic part shape and steps by powder metallurgy techniques, then finish machine the part.

With good tooling, close tolerances can be maintained, as shown in the accompanying chart. Class 2 gears and cams with follower radial tolerances of ±0.0005 inch and concentricities of 0.001 inch are being successfully fabricated. These tolerances can be maintained during the course of long production runs by using carbide tooling.

Part surface finishes are determined by the finishes of the briquetting or sizing dies. With highly polished dies, metal powder parts with gear teeth and cam peripheries have better finishes than can be produced by conventional machining.

Prototype Tooling: Three different types of tooling can be used for powder metallurgy parts—prototype tooling, pilot tooling and production tooling. Selection of the type of tooling to be employed is based on the physical and mechanical requirements for the part, relative cost per part, quantity requirements and the equipment available.

Prototype tools, *Fig.* 3, are low in cost and they are used for runs of one to several hundred pieces. Normally they are applied for making simple contoured shapes, with or without holes, and with one level. Secondary levels or other special areas are machined after the part is formed.

Prototype tools are ordinarily quite simple. Sectional or solid steel die inserts are utilized. Punches are simple and they do not have shoulders for clamping into punch holders. Pins are used for core rods. Tooling-up time ranges from a few days to three weeks.

Parts are usually molded in a single-motion platen press. To enable bottom compression, dies are spring-supported.

At IBM, prototype tooling is used to determine the feasibility of certain powder metallurgy applications and to expedite the production of parts for model machines. Other applications are to fabricate semifinished model parts in order to reduce machining time and, of course, to fabricate parts that cannot be made by other methods.

Before constructing prototype tools, the cost of tooling and the cost of any secondary operations should be compared with the cost of machining parts from cylindrical or rectangular blanks. On a unit cost basis, production with prototype tooling may not always be the best choice.

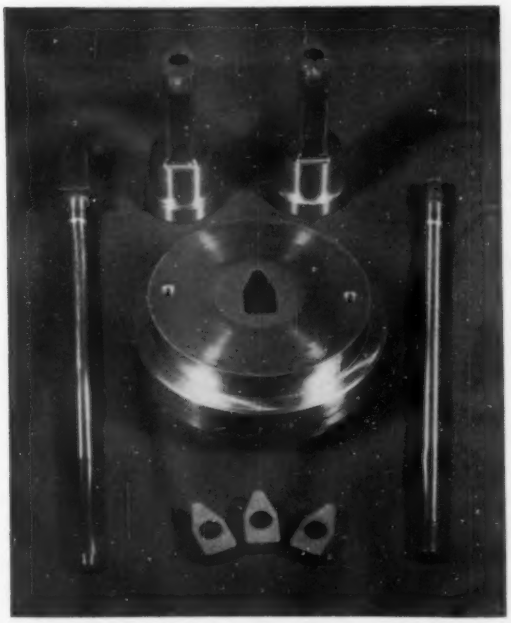


Fig. 4. Pilot tooling. Punches have shoulders, die is mounted for accurate alignment in press.

Pilot Tools: For many applications, it is better to use pilot tooling than prototype tooling. Pilot tools, *Fig.* 4, can be mounted in a die set or press with accurate alignment, permitting closer control of weight and dimensional tolerances, and faster production rates (100 to 1500 parts per hour). An added advantage is possible later conversion of pilot tooling to production tooling.

The cost of pilot tooling will in most cases be more than that for prototype tooling. Punches and core rods require shoulders for mounting and dies must be machined so that they can be mounted in a die holder. This raises tooling costs.

Production Tools: When making 2000 or more parts, production tooling, *Fig.* 5, is usually chosen. Fast presses are used, and the tools are mounted in a die set or in the press bed itself. Part contours, setups, holes and so on are built into the tools to eliminate as many secondary operations as possible. For high production, carbide die inserts, carbide core rods and, in some instances, carbide-tipped punches are employed.

At IBM, when a decision has been made to fabricate a production part by powder metallurgy techniques, a set of pilot tools is built for use in determining the feasibility of using the powder metallurgy process for the part. After preproduction trials, changes can be made in the pilot tool design to convert them into production tools. The completed production tools usually consist of a top punch, a bottom punch, a die and a core rod.

Die Design: After the type of tool design has been decided on, many details must be considered. The wall thickness of the die, for example, must be great enough to withstand stress on the die wall.

Die inserts must be shrink fitted into the outer die casing. Usually steel die inserts are made 0.0015-inch oversize; carbide die inserts are made 0.001 inch oversize. Carbide inserts are ordinarily $\frac{3}{16}$-inch thick.

For high production, the die should be of carbide. If it is to be used for high-pressure briquetting and repressing, the carbide die should be made in sections so that if fracturing occurs, the entire die will not be destroyed. If sufficient casing support can be built around the carbide inserts, a solid carbide insert can be used. The casing is usually of steel, hardened to R_C 40-45. Die and punch adapters are also made of this material.

For medium production runs, high-carbon, high-chrome steel is a satisfactory material. It has good abrasion resistance and it can be deep hardened

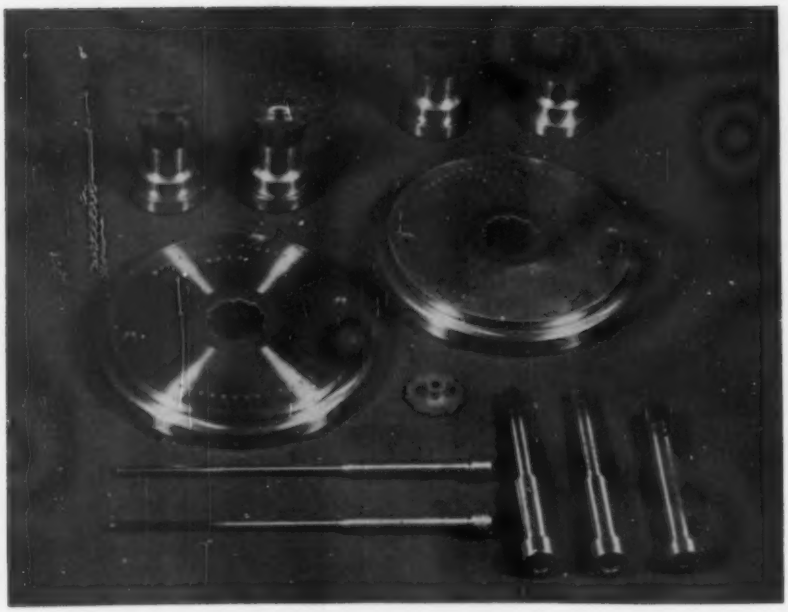


Fig. 5. Production tooling. Carbide is used for wear surfaces.

with minimum distortion. Many steel production dies can be produced by broaching. Internal splines are ground. These dies can be made up by pressing inserts into the die casing, fastening them with a clamp ring. This method permits checking the die, then removing the inserts for alteration if necessary.

Production dies should be designed so they can be reversed. In many cases the same die can be used for repressing to increase density.

The finish of die walls is usually specified as 5 microinches or finer. Grinding or lapping of a production die should be done in the direction of pressing to prevent any undercuts. The die flanges should be ground square with the inside diameter.

Ordinarily, punches are of high-carbon, high-chrome steel. If this material is too brittle for a given application, a standard oil hardening steel may be satisfactory. Punch ductility can be increased by a double draw after heat treating.

When considerable abrasion on the face of the punch anticipated, solid carbide or carbide-tipped punches are used. Carbide is also used where a step in the punch acts as a die to form the sides of a projection or a gear ratchet.

Heels of a punch should have clearance in the punch adapter. The inside and outside diameters are relieved to avoid drag on the dies or core rods.

Since core rods must withstand approximately the same amount of wear as die walls, the same material should be used for core rods as for dies. When core rod size permits, solid carbide is the best material to use. Because of the brittleness of carbide, it is not practical to use carbide when core rod diameter is 0.063 inch or smaller. Core rods of this size, particularly those that meet side pressure in the die, are normally of high-speed steel. In some cases a carbide sleeve or insert is brazed to a steel core rod. For low-density and medium-density parts, high-carbon, high-chrome steels are used, hardened to 60-63 R_C. Core rods with flame plated carbide coatings and core rods of several machinable carbides have been successfully used for production tooling. Normally, the clearance between the core rod and the OD of the punches, as well as the OD of the punches and the die, should be 0.0005 inch.

The general rules of part and tool design that have been given must be intelligently applied. When there is good cooperation and understanding between the part designer and the tool designer, optimum results will be achieved in production with the metallurgy process.

"Nonsense, of course I'm glad to see you—just dropped my pencil."

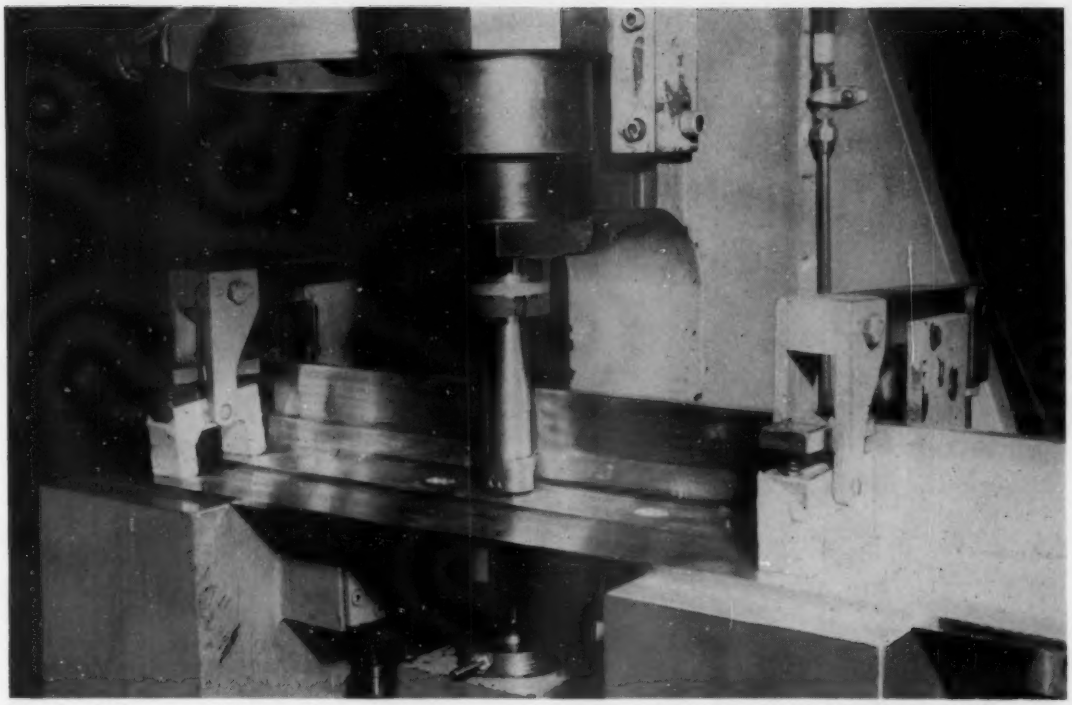


Fig. 1. Stationary coining machine, used for impressing compression grooves around a fuel transfer slot.

stressing for reliability

—coining increases component life

By Austin Phillips
Research Engineer
Douglas Aircraft Co.
Santa Monica, Calif.

Stresses created in a workpiece by manufacturing processes can cause early failure. But when stresses are specifically applied by coining around openings, they triple and quadruple fatigue resistance of components.

SPACE-AGE DESIGNS with their demands—more reliability, longer life, less weight, greater strength—are making the task of tool and manufacturing engineers more critical than ever. Functional needs of modern aircraft and missile components require that metals work harder and more effectively than ever before. Metals react to the stresses imposed upon them, whether by manufacturing processes or by service. When the stresses are repeatedly applied, the metal may reach its fatigue limit and fail. Even though fail-safe designs are generally used, over-all reliability of a system can be dependent on its weakest component.

Increasing Metal Life: There are often areas with stress raisers such as openings and corners that can lead to fatigue failure. These considera-

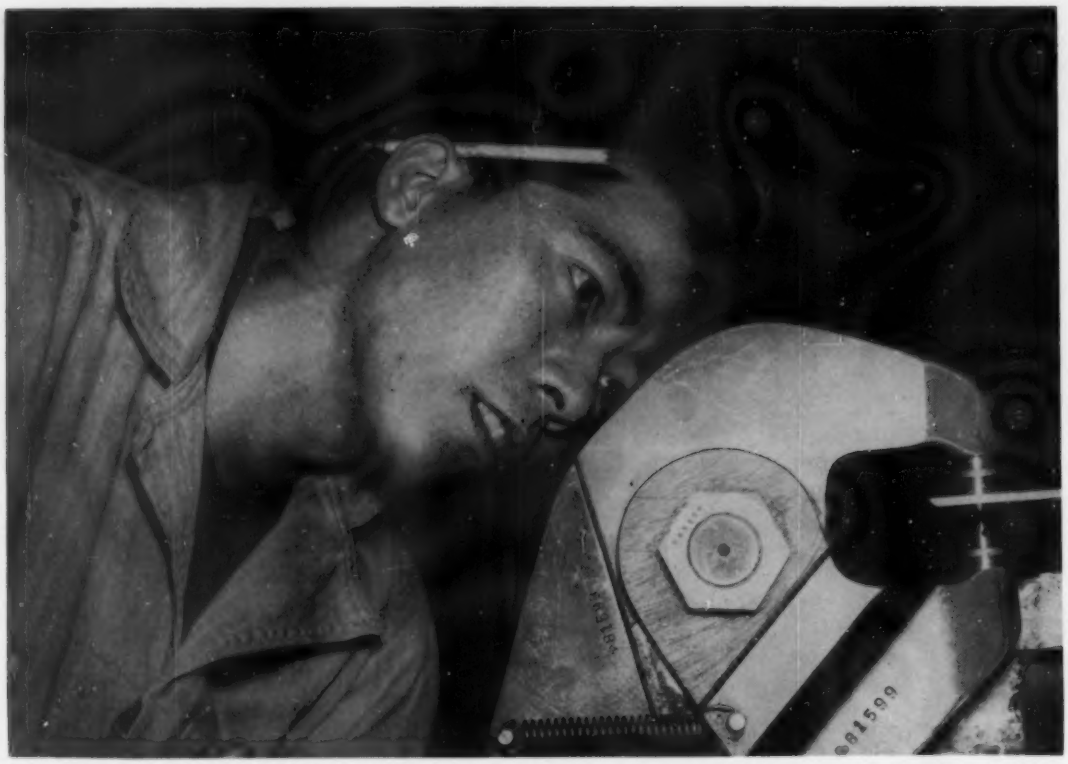


Fig. 2. Portable coining machine is used when it is more convenient or when the workpiece is extremely long.

tions led engineers at Douglas Aircraft Co. to investigate means of improving component life. Analysis revealed that great concentrations of tension stresses occurred around bolt holes, slots, and window frames. Realizing that metal is less susceptible to failure when in compression than in tension, manufacturing research engineers began to develop a process for combating metal fatigue. After five years of exhaustive tests and production experience, a special coining process was successfully developed to increase life.

Coining is generally used to finish the surface condition or to control the size and shape of metal but, in this special application of coining, the purpose is to set up internal conditions of stress in the metal. The process forms a groove of compressive stress adjacent to the areas of tension. By this means, the metal is preconditioned with compressive stresses and its life is prolonged. Early laboratory tests demonstrated the validity of the approach. One untreated DC-8 window frame developed a fatigue crack after 215,000 cycles of stress. Another window frame, identical except that its periphery was coined, showed no tendency to crack after 682,000 cycles. Workpiece failure was not yet in sight.

The coining process, *Fig.* 1, has proved successful on both high-strength aluminum alloys and steels. No particular operator skill is required. The exact technique to employ varies depending on the type of metal, thickness, area, and so forth and must be carefully established. The standards and procedures developed by Douglas must be observed to obtain the maximum benefit from the process. Detail design sometimes requires modification. Coining configuration and tooling must be carefully selected since misapplication of coining could lessen the life of a component instead of increase it.

Most production coining with this process has been performed on holes varying from 0.25 inch to 1 inch in diameter but almost any size of hole can be coined. The main limitations include the size of the die required and the pressure needed to properly coin the metal. The actual coining work is done in seconds. When a portable coiner is used, as shown in *Fig.* 2, the coining machine is sometimes counterweighted. This helps to lessen operator fatigue as he advances from hole to hole along the workpiece. When the coining is done on a stationary machine, as shown in *Fig.* 1, a table or rest is required to support long workpieces. No fixtures or other tooling is required.

With either the portable or stationary machine, coining time per hole is less than 15 seconds. The result—compressive stresses are locked in the workpiece in a deliberate and specific manner. These built-in stresses precondition the component, minimizing the tensile stresses it will encounter in service, thereby improving reliability.

Selecting Machinable Metals

—to extend tool life

By William Pentland, Research Supervisor
The Cincinnati Milling Machine Co.
Cincinnati, Ohio

MACHINABILITY is the relative ease or difficulty with which a material can be machined. More specifically, machinability can be described by three terms or quantities that a material exhibits when being cut. These are power required to cut the material, tool life, and the surface finish obtained on the workpiece. Factors affecting these three main quantities are friction, shear plane angle, tool temperature and the type of chip formation. The forces involved are different for different materials.

Power: Metalcutting is essentially a process of plastic deformation that occurs on a plane of shear, ahead of the cutting edge. The plastic deformation occurs by the utilization of power. The friction that arises between the chip and the tool as a chip slides over the tool is related to the shear angle. If friction is increased, the shear angle is decreased which results in an increased area of the shear plane. When the area to shear is larger, more force is required. Reducing friction between chip and tool increases the shear angle, thereby decreasing the shear plane area. Thus the force required to shear lessens and the power requirement decreases. Friction, and thus power requirements, can be reduced by the lubrication action of cutting fluids at the tool-chip interface.

Table 1—Nonferrous Metals

Material (type)	Machinability (percent)
Magnesium alloys	500-2000
Aluminum 11-S	500-2000
Aluminum 2-S	300-1500
Aluminum 17-S	300-1500
Brass, leaded F.C.C.D.	150- 600
Brass, yellow	200
Brass, red	200
Bronze, lead bearing	200- 500
Zinc	200
Gunmetal	60
Bronze, manganese	40
Copper, cast	70
Copper, rolled	60
Nickel	20
Monel metal, cast	35
Monel metal, rolled	45
Monel metal, "K"	50
Inconel	45
Everdur	60

Tool Life: These forces affect tool life, but tool wear rate is much more sensitive to the temperature of the tool. Heat is generated in two places—in the shear zone around the shear plane due to plastic deformation and at the tool-chip interface generated by the chip sliding over the tool face. Generation of heat raises the tool's temperature, reducing its hardness. This increases tool-to-chip welding and thus the rate of wear of the tool.

Finish: With high friction at the chip-tool interface, material tends to build up by welding to the cutting edge of the tool. The material hardens, becomes a cutting tool itself and increases to a point, then sloughs off. It then continues intermittently to build up and slough off, leaving a ragged

From "Machinability Theory and Application," by William Pentland, published by the Society of Carbide Engineers, Pittsburgh Chapter No. 10, Pittsburgh, Pa.

REFERENCE SHEET

finish to the workpiece surface.

Cutting forces, power, temperature, surface finish and the mechanics and geometry of chip formation affect the machinability of different materials. These considerations should be applied in using the accompanying tables, which are based on tool life. Each metal is rated by comparison (percentage-wise) with AISI B 1112, cold rolled or cold drawn, machined with a suitable cutting fluid at 180 fpm under normal cutting conditions. The ratings can serve as a starting point in selecting materials and in estimating tool life.

Table 2—Ferrous Metals

Material (AISI No.)	Machinability (percent)	Hardness (Bhn)
C 1110	85	137-166
C 1115	85	143-179
C 1117	85	143-179
C 1118	80	143-179
C 1120	80	187-229
C 1132	75	187-229
C 1137	70	187-229
C 1022	70	159-192
C 1016	70	137-174
B 1111	95	179-229
B 1112	100	179-229
B 1113	135	179-229
A 4023	70	156-207
A 4027*	70	166-212
A 4119	70	170-217
Mall. iron (ferritic)	100-250	120-200
Mall. iron (pearlitic)	70	190-240
Cast steel (0.35%C)	70	170-212
Stainless iron (free cutting)	70	163-207
C 1141	65	183-241
C 1020	65	137-147
C 1030	65	170-212
C 1035	65	174-217
C 1040*	60	179-229
C 1045*	60	179-229
A 2317	55	174-217
A 3045*	60	179-229
A 3120	60	163-207
A 3130*	55	179-217
A 3140*	55	187-229
A 3145*	50	187-235
A 4032*	65	170-229
A 4037*	65	179-229
A 4042*	60	183-235
A 4047*	55	183-235
A 4130*	65	187-229
A 4137*	60	187-229
A 4145*	55	187-229
A 4150*	50	187-235
A 4615	65	174-217
A 4640*	55	187-235
A 4815	50	187-229
A 5120	65	170-212
A 5140*	60	174-229
A 5150*	55	179-235
A 5045*	65	179-229
NE 8024	60	174-217
NE 8124	55	174-217
NE 8233*	60	179-229
NE 8339*	60	179-229
NE 8620	60	170-217
NE 8630*	65	179-229
NE 8724	65	179-229
NE 8739*	60	179-229
NE 8744*	55	183-235
NE 8749*	50	183-241
NE 8817	60	170-229
C 1008	50	126-163
C 1010	50	131-170
C 1015	50	131-170
C 1050*	50	179-229
C 1070*	45	183-241
A 1320	50	170-229
A 1330*	50	179-235
A 1335*	50	179-235
A 1340*	45	179-235
A 2330*	50	179-229
A 2340*	45	179-235
A 3240*	45	183-235
A 4340*	45	187-241
A 6120	50	179-217
A 6145*	50	179-235
A 6152†	45	183-241
A 9260*	45	187-255
NE 8442*	45	187-255
NE 8447*	40	187-255
NE 8949*	50	187-255
Ingot iron	50	101-131
Wrought iron	50	101-131
Stainless 18-8 F.M.	45	179-212
Cast iron	50	160-193
A 2515*	30	179-229
E 3310*	40	170-229
E 52100†	30	183-229
Ni-Resist*	30	
Stainless 18-8 (austenitic)*	25	-------
Manganese oil hardening steel†	30	-------
Tool steel, low tungsten, chromium and carbon†	30	-------
High-speed steel†	30	-------
High carbon-high chrome tool steel†	25	-------

* Annealed
† Spheroidized anneal

astme in action

For sketches of award recipients, see Page 95.

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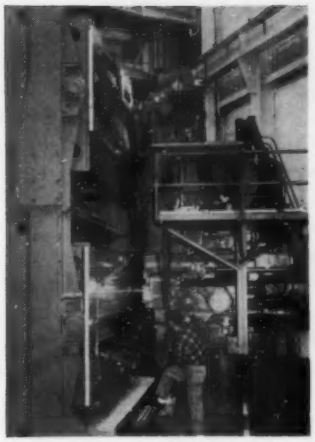

This towering horizontal hydrotel will be a high point of the Grumman tour on Long Island Day. During machining, the "venetian blind" chuck can tilt both the upper and lower machine tables to identical angles.

EXPLOSIVES

Form Long Island Program

A PROGRAM that should go over with a bang awaits those who attend Long Island Day during the Society's coming convention in New York. Not only will they hear the experts' views on the varied uses of explosives in the metalworking field, but they will actually see high-energy metalworking in process.

The day—Wednesday, May 24—will be spent entirely at the Grumman Aircraft Engineering Corp. facilities on Long Island and will be hosted by Long Island Chapter 88. Specially chartered buses bound for Grumman will depart from New York's Statler Hilton Hotel at the early hour of 8 a.m.

The morning on Long Island will be devoted to a technical session, consisting of three engineering papers followed by a discussion period. Chairman of the session is Henry Sjoman of Long Island chapter.

Starting off the program is a paper on "Welding, Forging and Cutting with Explosives" by Vasil Philipchuk, manager of the Special Projects Dept. at National Northern Div., American Potash & Chemical Corp. In this capacity Philipchuk conducts programs in the fields of both commercial and military explosives and directly supervises all company programs in explosive metal fabrication. Before joining National Northern, he spent ten years in charge of terminal ballistics at the U. S. Naval Proving Ground, Dahlgren, Va.

"Recent Developments in Explosive Forming at Grumman Aircraft" will be discussed by Arthur Wickesser, Jr., metallurgical engineer, and Arthur R. Garmendia, manufacturing engineer. Their paper will include a description of explosive forming methods used by Grumman in the manufacture of production parts, a detailed description of the calculations involved in a typical forming operation and illustrations of the application of these calculations.

Wickesser, who supervises and directs the explosive forming research and development program at Grumman, spoke at the 1959 Semiannual Meeting in St. Louis and recently served on an "Explosive Forming" panel at ASM's Western Metals Congress and Exposition. Garmendia has been with Grumman since 1951 and is presently working on the advanced development of formed parts.

The third paper, "Forming, Forging and Compaction of Space-Age Metals," will be presented by Guy C. Throner, manager of Aerojet-General Corp.'s Ordnance Div. Well-versed in his subject, Throner has worked with the California Institute of Technology in the Navy Rocket Program; established the Explosive Ordnance Branch at the Naval Ordnance Test Station, China Lake, Calif.; established Aerojet's large and diversified ordnance research and development organization; has written several papers in the field of explosives and ordnance research and development; and holds patents in the explosive and petroleum fields.

Long Island Day participants will be the guests of Grumman for lunch. Following luncheon is a two-and-a-half-hour engineering tour which will take the visitors out to Grumman's explosive forming facility for an actual demonstration of the new metalworking process. Other operations the group will inspect include chemical milling, vacuum brazing, various welding operations, numerically controlled machining, flow forming and assembly work.

Bill Peterson, Long Island chapter program chairman, heads the committee that has made all arrangements for the day-long program.

Society Sponsors Study of the Decimalized Inch

REPRESENTATIVES of 26 technical societies and industrial firms recently met in Detroit to begin an extensive and intensive study of the decimalized inch. The hosts were ASTME's National Standards Committee. The occasion was the organizational meeting of the American Standards Association sectional committee B-87, "Use of the Decimalized Inch."

Guest speaker Sidney W. Taylor, who is on the ASA staff, explained the Society's responsibilities as sponsor of the B-87 committee. It will be up to ASTME's National Standards Committee, he said, to approve the work of the sectional committee, to keep ASA informed of the progress of the work and to submit a completed standard, accompanied by a technical evaluation, to ASA for approval.

Extended Scope Proposed

One of the first official acts of the newly formed committee was a unanimous vote to reword the statement of its scope to include all industry. The revised scope of the committee—"to define the decimalized inch and to present preferred system (s) for its application"—is subject to the approval of the ASA Mechanical Standards Board.

B-87 Chairman Roy P. Trowbridge, director of engineering standards for General Motors Corp., said the committee would evaluate present applications of decimalized dimensioning. He pointed out that the aircraft industry has been using the decimal system since just prior to World War II and the automotive industry, since the postwar years. The machine tool and other industries have been much slower to adopt decimal usage, he noted.

In clarifying the mistaken idea that the use of decimals indicates close tolerance, Trowbridge emphasized that "decimal dimensioning does not imply anything in regard to tolerances." "If anything," he added, "the proper use of decimals allows the designer to specify broader tolerances whenever he so desires."

The committee considered the possibility of a standard based on the present preferred decimal system, which uses even increments of hundredths whenever possible. However, it was suggested that consideration of interchangeability and mating components may require much greater accuracy of dimensioning. Also up for discussion were the application of decimalized dimensioning to computing, the need for a standard terminology in decimal dimensioning, the problem of what to do with current fractional practices and the possible use of even numbers to facilitate conversion from fractional inches to decimals.

Seven subcommittees were appointed to develop recommendations and draw up draft proposals for incorporation into the standard at the next B-87 committee meeting. One of these subcommittees is investigating the feasibility of including the decimalization of the circle in the standard; another is developing a terminology, compatible with present systems, now in for subdivision and multiples of the inch.

Engineering Approach to Plastic Surgery

Plastic surgery is well within the province of the tool and manufacturing engineer, according to Dr. Bernard J. Sisson who recently told Syracuse ASTME members of the many opportunities for surgical tooling in this field. One example of surgeon-engineer cooperation, he said, is an instrument which removes minute particles of human skin for grafting purposes. Here, Dr. Sisson (left) displays his tools to First Vice Chairman Harold McNair (center) and Chairman Robert Metz. Plastic surgery is more properly termed reconstructive surgery, pointed out the doctor, and its main function is the rehabilitation of accident victims and congenitally deformed children, not glamorous face lifting. ***—Ed Luis***

AWARD OF MERIT

Recognizes Service to ASTME

SERVICE WITHIN AND FOR HIS CHAPTER, service to national committees and activities, local promotion of Society prestige and service to the community—these are the achievements and contributions of each of the ten members selected to receive this year's ASTME Award of Merit.

Nominated by their home chapters and elected by the National Honor Awards Committee, the Award of Merit winners will receive recognition in the form of an etched metal plaque mounted on a walnut panel. The recipient's name and the year of conferral will be inscribed on the plaque.

Presentation of the awards, performed by the chapters involved, will be made to the following:

Ben J. Hazewinkel, LOS ANGELES—A member of the Society since 1941, Hazewinkel is president of Daily Grinding, Inc. Temporary chairman during the organization of Denver chapter, he chairmanned that group for two years after its chartering in 1947. In 1955 he was chairman of the California Council of Chapters and a member of Los Angeles chapter's constitution and bylaws committee. Hazewinkel has successively held the posts of second vice chairman, first vice chairman and chairman of the L. A. chapter and has served on the National Progress, Nominating, Membership and Public Relations committees. He has been influential in the formation of some 17 ASTME chapters.

Paul H. Magnus, II, PITTSBURGH—One of his major contributions to the Pittsburgh chapter was the initiation of the annual ASTE Forum at the Carnegie Institute of Technology. Since joining the Society in 1947, Magnus has served the Pittsburgh group as first vice chairman, chairman and member of the executive advisory committee. His five years of service on the chapter editorial committee included one term as chairman and another as co-chairman. He has also been an active member of the Pittsburgh public relations and education committees. Executive vice president of Rosedale Foundry & Machine Co., Magnus has taken advantage of his affiliation with numerous business, civic, industrial and social organizations to advance recognition of and respect for ASTME.

C. J. McDowell, MONTREAL—Presently engaged in the organization of a Quebec City chapter, McDowell has been one of the mainstays of Montreal chapter for the past 10 years. In addition to serving on the constitution and bylaws, chapter advisory and auditing committees, he was Montreal's treasurer from 1947 to 1950, second and first vice chairman in 1951 and 1952, respectively, and chairman in 1953. As chairman, he established out-of-town meetings and also fostered a membership drive which raised the membership from 200 to 265. Through McDowell's efforts, Montreal chapter is this year holding its first On-Campus Conference. He is supervisor of tool design and manufacturing for the Dominion Engineering Works Ltd.

Clarence L. Miller, ST. LOUIS—Vice president of Measuregraph Co., Miller has held the chairmanship of St. Louis chapter's membership, entertainment, honor awards, constitution and bylaws, and nominating committees. He headed the chapter in 1942 and prior to that, served as secretary. Chairman of the reception committee for the 1959 Semiannual Meeting in St. Louis, he was also co-chairman of the 1942 Annual Meeting in that city. Miller has served as vice chairman of the National Industrial Relations Committee for Area D and he is one of the founders of the St. Louis chapter.

Fred D. Mondin, PORTLAND (Ore.)—Under Mondin's leadership, Portland chapter membership

soared from 49 in 1953 to 133 in 1954. Following his term as chapter chairman, he headed the program and membership committees. During his chairmanship of the standards committee, the group handled the National Standards Committee project on keys, keyseats and keyways. Mondin served on the National Membership Committee in 1958 and 1959 as area captain. General superintendent of the Willamette Iron and Steel Co., he works in the training of apprentices and often assists the Oregon State College student chapter. He joined the Society in 1937 as a member of Pittsburgh chapter.

William E. Rutz, FOND DU LAC—Because he sent out the call for the preorganization meeting of the Fond du Lac chapter back in 1941, he is known as the "father" of Chapter 45. In addition to holding the post of chairman, Rutz has headed the chapter's industrial relations and constitution and bylaws committees and served on the nominating committee. In 1959, he was appointed to the ASTME Research Fund Committee. Outstanding management service to Giddings & Lewis Machine Tool Co., where he is executive vice president, won for him in 1960 the "Gold Knight of Management" award, presented by the Wisconsin Council of the National Management Association.

Gordon Swardenski, PEORIA—An education program on grinding problems; a plan to interest high school students in tool engineering as a profession; the establishment of the Peoria Engineering Council; a series of meetings covering the proper use of cutting tools, machine tool design and time-study methods and applications—these are but a few of Swardenski's contributions as first vice chairman and chairman of his chapter. In 1950 he served on the National Book Committee and in 1958 he was a member of the project committee for the ASTE Research Fund cutting fluid project. Swardenski is director of manufacturing at Caterpillar Tractor Co.

Llewellyn H. Tenney, MID-HUDSON—A member of the committee that organized Mid-Hudson chapter, Tenney has served that group as chairman and secretary. While chairman of the editorial and public relations committees, he established initial contacts with the local press and, as chairman of the education committee, arranged for various technical courses in the local high school adult education system. Prior to his retirement from the DeLaval Separator Co. in 1954, he actively recruited membership in the Society among members of company management as well as employees in tool engineering and design departments. Tenney also established an annual Industry Night for honoring heads of local industries.

William A. Thomas, WINDSOR—Retired superintendent of manufacturing and engineering at the machine shop and stamping plant of Ford Motor Co. of Canada, Ltd., Thomas is a charter member of the Windsor chapter. Prior to his election as Windsor chairman in 1949, he was ASTE representative to the Canadian Standards Association and held the chapter posts of second and first vice chairman. In 1950 he was ASTME's national assistant treasurer and in 1951, national secretary. In 1953 and 1957, he was a member of the National Nominating Committee. Thomas served six consecutive years on the National Standards Committee and three terms on the Board of Directors.

Chris A. Vogt, HOUSTON—Vogt, a charter member of Houston chapter, has served that group as treasurer, first vice chairman and chairman. During his chairmanship of the education committee, he organized a group of chapter members as counselors for engineering students at local universities and technical schools. From 1945 to 1947 he served on the National Education Committee. He has headed the Engineers' Council of Houston and his active participation in the Houston Engineering & Scientific Society has acquainted many technical and scientific people with ASTME. As associate professor of engineering at the University of Houston, Vogt helped organize and sponsor the university's ASTME student chapter. He presently heads his own consultant engineering firm in Houston.

1962 Convention Site Changed

Site of the 1962 ASTME Convention and Tool Exposition has been changed from Detroit to Cleveland by the Society's Board of Directors.

In announcing the change of exposition site from Detroit's Cobo Hall to Cleveland's Municipal Auditorium, General Manager Harry E. Conrad, under the authorization of the Board of Directors, stated: "We realize that many of the problems in connection with beginning the operation of a facility the size of Cobo Hall are unavoidable. The situation that continues to prevail at this new facility is not conducive to giving our exhibitors the firm assurance they demand. As a result, we are in no position to hazard the success of our meeting on the contingency that another year of experience will eliminate uncertainty."

PRODUCTIVITY PROGRAM '61

The ASTME 1961 Manufacturing Engineering Conference and Tool Exposition

May 22–26 New York City

There's a new star on the metalworking horizon—Productivity '61, the ASTME New York Engineering Conference and Tool Exposition. Here is your opportunity to learn all about the latest developments in manufacturing.

At the Engineering Conference you'll have a chance to hear more than 50 experts discuss new processes, methods and equipment. You'll be able to participate in three Techtours—combined engineering sessions and plant tours—and you can tour 10 of America's leading plants to see productive efficiency in action.

You'll see thousands of exhibits at the Tool Exposition in the New York Coliseum—the nation's largest display of machines, tools, tooling, gaging, and manufacturing materials and equipment of all kinds. All the details are contained in this Productivity Program.

Open Here

Mail to: MISS SYLVIA PELTONEN, ASTME HOUSING BUREAU
90 EAST 42ND STREET, NEW YORK, N. Y.

Indicate your choice of hotels and accommodations by putting X's in the appropriate boxes. Write in the names of your second-choice and third-choice hotels below. Also write in the approximate room rate you wish to pay.

HOTEL		SINGLE ☐	DOUBLE ☐	TWIN ☐	SUITE ☐
Governor Clinton	☐	$8.00—$13.00	$13.00—$17.00	$14.00—$19.00	$24.50—$37.50
Henry Hudson	☐	$7.00—$12.00	$11.00—$16.00	$12.00—$18.00	$20.00—$50.00
New Yorker	☐	$8.00—$14.50	$11.50—$18.00	$15.50—$20.00	$35.00 up
Park-Sheraton	☐	$12.00—$15.00	$16.00—$19.00	$16.00—$19.00	$25.00—$38.00
Sheraton-Atlantic	☐	$8.50—$14.00	$13.00—$18.00	$14.00—$18.00	$22.00—$38.00
Statler Hilton (Headquarters hotel)	☐	$8.50—$14.00	$11.00—$18.00	$15.00—$24.00	$36.00—$65.00

DESIRED ROOM RATE $	SECOND-CHOICE HOTEL	THIRD-CHOICE HOTEL

YOUR NAME	ARRIVAL DATE	ARRIVAL TIME AM PM	DEPARTURE DATE

COMPANY	STREET	CITY	STATE

NAMES OF PERSONS SHARING ROOM

1. _____ ARRIVAL DATE_____ ARRIVAL TIME_____ AM PM

2. _____ ARRIVAL DATE_____ ARRIVAL TIME_____ AM PM

Mail to: ADVANCE REGISTRATIONS, ASTME, 10700 PURITAN, DETROIT 38, MICH. ADVANCE REGISTRATIONS NOT ACCEPTED AFTER MAY 1. THEN REGISTER AT CONFERENCE OR EXPOSITION ONLY.

CONFERENCE AND EXPOSITION REGISTRATION (ASTME members $1.00—others $2.00)	NO	TOTAL	LADIES' ACTIVITIES	NO.	TOTAL
		$			
Honor Awards Dinner ($8.00)		$	Getting To Know You (Free)		
Eli Whitney Luncheon ($6.00)		$			
Annual Banquet ($10.00)		$	Ship Ahoy ($2.00)		$
Surface Metrology Seminar (ASTME members $45.00—others $60.00)		$	New York, N. Y. ($3.25)		$
Numerical Control Techtour (ASTME members $3.00—others $5.00)		$	United Nations ($2.50)		$
High-Energy Metalworking Techtour (ASTME members $3.00—others $5.00)		$	Anchors Aweigh ($3.00)		$
Material Removal Progress Symposium (ASTME members $3.00—others $5.00)		$	Design-o-Rama ($2.75)		$
Manufacturing Operations Management Techtour (ASTME members $3.00—others $5.00)		$	TOTAL REMITTANCE		$
Plant Tours ($2.00 each—circle numbers of tours desired below) 1 2 3 4 5 6 7 8 9		$	Please send me free order blank for conference papers ☐		

NAME	COMPANY	PRODUCT

TITLE	STREET	CITY	STATE

NAME OF BENEFICIARY (for free insurance)	RELATIONSHIP	ARE YOU AN ASTME MEMBER? YES ☐ NO ☐

Make checks payable to The American Society of Tool and Manufacturing Engineers.

MAKE HOTEL RESERVATIONS NOW!

Some of New York's finest hotels are holding blocks of rooms for Engineering Conference and Tool Exposition registrants.

To make sure you have good accommodations, clip and fill out the above coupon.

Your reservation will be quickly confirmed by the Bureau.

Headquarters for the Engineering Conference will be in the Statler Hilton Hotel. The Technical Sessions, the Surface Metrology Seminar and the Material Removal Progress Symposium will be held at the Statler Hilton Hotel.

Note: Every effort will be made to see that you have the type of accommodations you desire in the hotel of your choice. If your first-choice hotel is filled, it may be necessary to reserve a room for you in your second-choice or third-choice hotel.

SAVE TIME IN NEW YORK! REGISTER NOW!

With this handy coupon, you can register in advance for the Engineering Conference and Tool Exposition without waiting in line. Your Time Saver Badge will be sent to you promptly.

An added bonus—if you register before May 1, you will receive a $10,000 life insurance policy* free!

The coupon can also be used to make reservations for all special events and special features of the Technical Program.

*This death and dismemberment policy, issued by the Bankers Life and Casualty Company of Chicago, will give 24-hour-a-day protection to early registrants. It provides coverage while on a trip to, while there and while returning from the ASTME Engineering Conference and Tool Exposition. Any member or guest who registers prior to May 1, 1961 is covered, subject to the terms and conditions of Policy SR80872.

General Information '61

REGISTRATION

Advance registration—using the coupon provided elsewhere in this Productivity Program—will save you time and trouble in New York. Or you can register at conference headquarters on the west end of the first mezzanine foyer of the Statler Hilton Hotel on Sunday, May 21 (4 to 8 pm); Monday, May 22 through

Electrolux Corp., Ford Motor Co., Fred Heinzelman & Sons, Pitney-Bowes, Inc., American Machine & Foundry Co., Lycoming Div. of Avco Corp., International Business Machines Corp., and Adamas Carbide Corp. A $2.00 charge is made for round-trip bus transportation. Advance reservations are advisable.

LADIES' ACTIVITIES

A ladies' headquarters and lounge will be maintained in the Hartford Room on the first mezzanine floor of the Statler Hilton Hotel. Ladies may register (at no charge) with their husbands. Special ladies' activities are planned for each day—Monday through Friday.

the west end of the first mezzanine foyer of the Statler Hilton Hotel on Sunday, May 21 (4 to 8 pm); Monday, May 22 through Thursday, May 25 (7:30 am to 3 pm); and Friday, May 26 (7:30 to 10 am). You can also register at the Tool Exposition registration center in the New York Coliseum during exposition hours. The registration fee is $1.00 for ASTME members, $2.00 for others. This fee covers admission to the Tool Exposition and to most technical program sessions. Exceptions are noted elsewhere in this program.

TOOL EXPOSITION

The Tool Exposition will be at the New York Coliseum. Literally thousands of products of interest to tool and manufacturing engineers and manufacturing executives will be shown.

Visitors are encouraged to bring their manufacturing problems to the Exposition. Hundreds of experts on all phases of manufacturing are prepared to demonstrate how these problems can be solved.

TECHNICAL PAPERS

Over 50 papers will be presented at technical sessions during the course of the Engineering Conference. These will cover surface metrology, operations research, numerical control, high energy rate forming, electrolytic metal removal, manufacturing operations management and other key subjects.

TECHTOURS, PLANT TOURS

Techtours combine engineering discussions with a plant tour to see the operations discussed. There will be three Techtours—one to Republic Aviation Corp., one to International Business Machines Corp. and one to Grumman Aircraft Engineering Corp. Advance reservations are necessary. The fee for each Techtour is $3.00 for ASTME members, $5.00 for others.

The nine plant tours include visits to Brooklyn Navy Yard, advisable.

SURFACE METROLOGY SEMINAR

This is a two-day program featuring twelve engineering discussions on surface specifications, surface measurement techniques and future developments in this field. Advance registration is necessary. The fee is $45.00 for ASTME members, $60.00 for others. This fee includes registration for the Engineering Conference and Tool Exposition.

MATERIAL REMOVAL PROGRESS SYMPOSIUM

A one-day workshop devoted to new developments in metal removal. Participants will have an opportunity to discuss metal-cutting problems with experts. Advance registration is necessary. The fee is $3.00 for ASTME members, $5.00 for others.

SPECIAL EVENTS

Many special events are planned. These include a Public Affairs Forum in which a panel of experts will compare Russian and American manufacturing industries, and yearly ASTME functions—the Honor Awards Dinner, Eli Whitney Luncheon, Annual Banquet Party, and ladies' activities. These are described elsewhere in this Productivity Program. Tickets can be purchased by mail for these events—use the advance registration coupon in this program—or they can be purchased at conference headquarters.

HOTEL RESERVATIONS

Advance hotel reservations are advisable. These can be made through the ASTME Housing Bureau, using the coupon in this Productivity Program.

husbands. Special ladies' activities are planned for each day—Monday through Friday.

Suits are usually worn in New York in May—it is not warm enough for cottons. For outdoor wear, a suit with a light coat is sufficient.

HONOR AWARDS DINNER

Announcement and Presentation of Six
ASTME National Honor Awards

Progress Award
Robert G. LeTourneau, founder and president
R. G. LeTourneau, Inc.

Gold Medal
Dr. Leo P. Tarasov
Research and Development
Norton Company

Joseph A. Siegel Memorial Award
Albert Marden Sargent, owner
A. Sargent Consulting Engineer

Engineering Citation
John Finlay, retired

Education Award
Lawrence E. Doyle, professor
Mechanical Engineering
University of Illinois

Research Medal
Dr. William W. Gilbert, manager
Machinability Development Service
General Electric Company

Dinner: $8.00 — Saturday, 7:30 pm
Statler Hilton Hotel — Grand Ballroom

A Productive Week...

MONDAY, MAY 22

Exposition hours: 1:00 pm—9:00 pm

7:30 am Canadian Chapter Breakfast
8:15 am Surface Metrology Seminar registration
9:30 am Technical Session—Recent Tool and Manufacturing Developments
10:30 am Ladies' Activity—Getting to Know You
12:00 Eli Whitney Luncheon
1:00 pm Ladies' Activity—Ship Ahoy!
1:00 pm Tour 1—Brooklyn Navy Yard
2:30 pm Technical Session—Operations Research

TUESDAY, MAY 23

Exposition hours: 1:00 pm—9:00 pm

8:30 am Tour 2—Electrolux Corp.
8:30 am Tour 3—Ford Motor Co.
8:30 am Techtour—Manufacturing with Numerical Control Systems
9:00 am Tour 3a—Ford Motor Co.
9:00 am ASTME Board of Directors Meeting
9:15 am Technical Session—Press Tooling Progress
9:30 am Technical Session—Grinding
1:00 pm Tour 4—Fred Heinzelman & Sons, Inc.
1:00 pm Ladies' Activity—New York, New York
2:00 pm Public Affairs Forum—Race for Manufacturing Supremacy
2:00 pm Technical Session—Automation and Numerical Control

WEDNESDAY, MAY 24

Exposition hours: 9:00 am—6:00 pm.

8:00 am Techtour—High-Energy Metalworking (Long Island Day)
8:30 am Tour 5—Pitney-Bowes, Inc.
8:30 am Tour 6—American Machine & Foundry Co.
9:00 am ASTME Board of Directors Meeting
9:15 am Symposium—Material Removal Progress
9:30 am Technical Session—Powder Metallurgy
10:00 am Ladies' Activity—United Nations
2:15 pm Technical Session—Numerically Controlled Machining
6:30 pm Social Hour and ASTME Annual Banquet

THURSDAY, MAY 25

Exposition hours: 9:00 am—6:00 pm

8:30 am Tour 7—Lycoming Div., Avco Corp.
8:30 am Tour 8—Poughkeepsie plant, IBM Corp.
9:00 am Techtour—Manufacturing Operations Management
9:15 am Technical Session—Workholding Developments
9:30 am Technical Session—Appraising the Manufacturing System
12:00 Educators' Luncheon-Conference
12:45 pm Ladies' Activity—Anchors Aweigh
1:00 pm Tour 9—Adamas Carbide Corp.
2:00 pm Technical Session—Cutting Tool Materials
2:30 pm Technical Session—Material Removal

FRIDAY, MAY 26

Exposition hours: 9:00 am—6:00 pm

9:00 am Technical Session—Tracer and Numerical Control Systems
9:30 am Technical Session—Tool Engineering Progress
10:00 am Ladies' Activity—Design-O-Rama

Monday, May 22

'61

Tool Exposition Hours: 1:00 pm–9:00 pm

SPECIAL EVENTS

Canadian Breakfast. Sponsored by the ASTME chapters of Canada for Canadian members and visitors and their guests. TIME: 7:30 am. PLACE: Dartmouth Room, Statler Hilton Hotel.

Fifth Annual Eli Whitney Memorial Lecture. Speaker: Wallace E. Brainard—chief engineer, Servo Machine Tool Div., Kearney & Trecker Corp. Subject: "Put the Skill in the Machine." TIME: 12:00 noon. PLACE: Grand Ballroom, Statler Hilton Hotel. TICKET: $6.00.

PLANT TOUR

Brooklyn Navy Yard (Tour 1). Visit to aircraft carrier Constellation and to the machine shop, sheet-metal shop and welding shop. Extra-large work is handled in all of these shops. Visitors must be U. S. citizens. No cameras permitted. TIME: 1:00—5:00 pm. Buses depart from the Statler Hilton Hotel, return to the Coliseum. TICKET: $2.00.

TECHNICAL SESSIONS

Recent Tool and Manufacturing Developments. Chairman: Julius Schoen—president, Arista Design & Process Corp. TIME: 9:30—11:30 am. PLACE: East Room, Statler Hilton Hotel. Topics:

"Fiber Optics—New Twists in an Old Science" (Paper 368) by Stephen M. MacNeile—director of research, American Optical Co.

"Effect of Catalyst Variations on the Bonding Properties of Epoxy Adhesives" (Paper 367) by Kenneth W. Carroll—manager, technical service, Rubber and Asbestos Corp.

Operations Research. Chairman: Walter A. Stadtler—director of manufacturing research, International Business Machines Corp. TIME: 2:30—4:30 pm. PLACE: West Room, Statler Hilton Hotel. Topics:

"Operations Research—Concepts, Techniques and Applications" (Paper 372) by Nicholas J. Radell—senior consultant, Touche, Ross, Bailey & Smart.

"Case Study in Operations Research Manufacturing" (Paper 371) by Gerald J. Demirjian—operations research analyst, Touche, Ross, Bailey & Smart.

SURFACE METROLOGY SEMINAR

This is a two-day program of paper presentations, discussion periods, a problem clinic and an open forum designed to present a comprehensive view of the latest advancements in the fields of surface specifications, surface measurement techniques and future requirements in this field. TIME: Register from 8:15 to 9:15 am, Monday, May 22. Times of sessions given below. PLACE: Gold Ballroom, Statler Hilton Hotel. TICKET: $45.00 for ASTME members, $60.00 for others. (Nonmembers may apply the difference in fees to ASTME membership.) The fee covers attendance at all Seminar sessions, a complete bound set of the Seminar papers, all coffee breaks and two luncheons, including the Eli Whitney Luncheon. The fee also includes registration for the Engineering Conference and Tool Exposition.

Surface Specifications. Chairman: Richard C. Prentice—production foreman, Lycoming Div., Avco Corp. TIME: 9:15—10:30 am. Topics:

"The Science of Surface Metrology" (Paper 338) by R. E. Reason—Taylor, Taylor-Hobson Ltd., Leicester, England.

"Understanding the Language of Metrology" (Paper 339) by Arnold W. Young—supervisor, Engis Equipment Co.

Surface Specifications and Measurement. TIME: 10:45 am—12 noon. Topics:

"Surface Finish and Other Surface Specifications" (Paper 340) by Fred W. Witzke—Cleveland Instrument Co.

"Controlling Surface Finishes with Interferometers" (Paper 341) by Erwin G. Loewen—head-metrology research, Bausch & Lomb, Inc.

Surface Measurement. Chairman: Harry B. Randall, Jr.—branch manager, Pratt & Whitney Machine Tool Co. TIME: 2:30—4:30 pm. Topics:

"The Application of Stylus Inspection Methods in Ball and Bearing Manufacture" (Paper 346) by Dale A. Cue—quality manager, Hoover Ball and Bearing Co.

"The Use of Precision Surface Finish Comparison Specimens" (Paper 345) by Frank R. Bottomley—Fairfield Development Laboratories, Inc.

Problem Clinic: Registrants can discuss individual measurement problems at this session. TIME: 7:30—9:00 pm.

LADIES' ACTIVITIES

Getting To Know You. Initial get-acquainted party. TIME: 10:30 am. Place: Hartford Room, Statler Hilton Hotel. No charge. Coffee and sweet rolls will be served.

Ship Ahoy. A tour of Brooklyn and the Brooklyn Navy Yard. Visit to an aircraft carrier. Walking shoes recommended. No luncheon stop. TIME: 1:00—5:00 pm. TICKET: $2.00.

Tuesday, May 23

'61

Tool Exposition Hours: 1:00 pm–9:00 pm

SPECIAL EVENTS

"A New and Realistic Look at Grinding Wheel Procedures" (Paper 336) by Carle W. Highberg—head, diamond development engineering, Industrial Diamond Div., Engelhard

swer questions and discussion problems presented to them by Seminar registrants. Moderators will be announced. TIME: 3:15—4:30 pm

SPECIAL EVENTS

ASTME Board of Directors Annual Meeting. All members are welcome. TIME: 9:00 am—5:00 pm. PLACE: Penn Top Ballroom, Statler Hilton Hotel.

Public Affairs Forum. "Race for Manufacturing Supremacy." Experts from industry, government and education will give first-hand reports on advances made by Russian technologists and engineers, based on recent visits to Russian manufacturing plants. Russian progress will be compared with our own. TIME: 2:00 pm. PLACE: Columbia University Campus. No charge. Everyone is welcome.

PLANT TOURS

Electrolux Corp. (Tour 2). Stamping, machining, die casting, material handling and finishing operations will be seen in a plant that manufactures vacuum cleaners and floor polishers. TIME: 8:30 am—12:30 pm. Buses start from and return to the Statler Hilton Hotel. TICKET: $2.00.

Ford Motor Co. (Tour 3). Mahwah assembly plant. Visitors will see complete automotive assembly operations. TIME: 8:30 am—12:00 noon. Buses start from and return to the Statler Hilton Hotel. TICKET: $2.00. (Tour 3a, leaving the hotel at 9:00 am and returning at 12:30 pm also covers the Ford Mahwah plant.)

Fred Heinzelman & Sons, Inc. (Tour 4). Visitors will see automatic hardening, quenching, washing, drying and tempering operations in one of the most modern heat-treating plants in the country. TIME: 1:00—5:00 pm. Buses start from the Statler Hilton Hotel and return to the Coliseum. TICKET: $2.00.

TECHNICAL SESSIONS

Press Tooling Progress. Chairman: James L. G. Fitz Patrick—dean, Staten Island Community College. TIME: 9:15—11:15 am. PLACE: West Room, Statler Hilton Hotel. Topics:

"Increased Application of Stress Designed Rule Tooling in Industry" (Paper 353) by Lawrence M. Rheingold—president, and Charles F. Hazzard—vice president, Templet Industries Inc.

"Fabrication of Composite Dies" (Paper 352) by Joseph F. Quaas—vice president-research and manufacturing, Eutectic Welding Alloys Corp.

Grinding. Chairman: Gerald Abbot—general manager, Everard Tap & Die Corp. TIME: 9:30—11:30 am. PLACE: East Room, Statler Hilton Hotel. Topics:

"Those Elusive Millionths" (Paper 333) by Harold S. Sizer—director of design, Brown & Sharpe Manufacturing Co.

(Paper 336) by Carle W. Highberg—head, diamond development engineering, Industrial Diamond Div., Engelhard Hanovia, Inc.

Automation and Numerical Control. Chairman: Wallace T. Fullenwider—production manager, Austin Electronics Div., the Austin Co. TIME: 2:00—4:00 pm. PLACE: West Room, Statler Hilton Hotel. Topics:

"The Evolution of the Numerically Controlled Machining Center" (Paper 360) by Carl B. Perry—product manager, Industrial Systems Div., Hughes Aircraft Co.

"Economic and Technical Feasibility Analyses for Automation" (Paper 361) by Richard S. White—president, Automation Engineering Laboratory, Incorporated.

SURFACE METROLOGY SEMINAR

This is a continuation of the Surface Metrology Seminar starting on Monday, May 22. See Monday's schedule for details. All sessions are in the Gold Ballroom, Statler Hilton Hotel.

Surface Measurement. Chairman: Fred W. Bechtold—chief engineer, S. S. White Dental Manufacturing Co. TIME: 9:00—10:30 am. Topics:

"The Use of Ultrasonics for the Detection of Discontinuities" (Paper 347) by John E. Bobbin—Branson Instruments, Inc.

"A Measuring System for Displacements of Less Than One Microinch" (Paper 348) by Gardner P. Wilson—chief engineer, Brush Instruments Div. of Clevite Corp.

Surface Specifications in Manufacturing Operations—1 TIME: 10:45 am—12 noon. Topics:

"Equipment Design and Machining Applications for Better Surface Finish" (Paper 349) by Clarence Kooistra—corporate quality manager, Marlin-Rockwell Corp.

"Precision Grinding the Required Surface Finish" (Paper 342) by Richard J. Levi—president and general manager, Electro-Autosizing Machine Corp.

Surface Specifications in Manufacturing Operations—2 Chairman: Jacob H. Sperman—owner, Sperman Metal Specialties. TIME: 1:30—3:00 pm. Topics:

"The Application of Burnishing in Parts Finishing" (Paper 344) by Edwin B. Krause—president, Madison Industries Corp.

"A Preview of Surface Requirements and Specifications for the Future" (Paper 343) by Charles H. Good—plant manager, and Frank W. Kabat—Micrometrical Manufacturing Co.

Open Forum Discussion Period. All speakers will answer questions from Seminar registrants. Moderators will be announced. TIME: 3:15—4:30 pm.

TECHTOUR—MANUFACTURING WITH NUMERICAL CONTROL SYSTEMS

This one-day program combines technical paper presentations, a tour of Republic Aviation Corporation's numerical control facility and a discussion period. The fee is $3.00 for ASTME members and $5.00 for others. This fee covers attendance at all sessions of the Techtour, copies of the engineering papers and round-trip bus transportation between the Statler Hilton Hotel and Republic Aviation Corp. Advance reservations are necessary.

Session "A"—Engineering Papers. Chairman: William M. Rynack—assistant professor of automation, New York City Community College. TIME: 8:30—10:30 am. PLACE: Georgian Room, Statler Hilton Hotel. Topics:

"Auto-Prompt, A Three Dimensional System for Numerical Control" (Paper 358) by Samuel M. Matsa—senior analyst, Mathematics & Applications Dept., Data Systems Div., International Business Machines Corp.

"Planning a Maintenance Program for Numerical Control Equipment" (Paper 356) by James J. Childs—administrator, machinery modernization program, Republic Aviation Corp.

"Numerical Control Retrofit of Machine Tools" (Paper 357) by William B. Johnson—industrial engineer and chairman of the numerical control coordinating committee, Rocketdyne, Div. of North American Aviation, Inc.

Session "B"—Engineering Tour. Visitors to Republic Aviation Corp. will see a complete battery of tape-controlled machines in action—two conventional profilers, two skin mills and a five-axis profiler. Final assembly of an advanced fighter-bomber will also be seen. All persons taking this tour must be U.S. citizens. Buses depart from the Statler Hilton Hotel at 12:00 noon.

Session "C"—Panel Discussions. TIME: 4:40 pm. PLACE: Cornell-Dartmouth Room, Statler Hilton Hotel. The speakers from the morning sessions and engineers from Republic Aviation will answer questions on numerical control.

LADIES' ACTIVITY

New York, New York. Tour covering Times Square, Herald Square, Greenwich Village, the Bowery, Civic Center, City Hall, Lower Broadway, St. Paul's Chapel, Trinity Church and Bowling Green. The trip will also include a walking tour of Chinatown and a guided tour of the Stock Exchange. No luncheon stop. Walking shoes recommended. TIME: 1:00—4:15 pm. TICKET: $3.25.

Mail to: MISS SYLVIA PELTONEN, ASTME HOUSING BUREAU
90 EAST 42ND STREET, NEW YORK, N. Y.

Indicate your choice of hotels and accommodations by putting X's in the appropriate boxes. Write in the names of your second-choice and third-choice hotels below. Also write in the approximate room rate you wish to pay.

HOTEL		SINGLE ☐	DOUBLE ☐	TWIN ☐	SUITE ☐
Governor Clinton	☐	$8.00—$13.00	$13.00—$17.00	$14.00—$19.00	$24.50—$37.50
Henry Hudson	☐	$7.00—$12.00	$11.00—$16.00	$12.00—$18.00	$20.00—$50.00
New Yorker	☐	$8.00—$14.50	$11.50—$18.00	$15.50—$20.00	$35.00 up
Park-Sheraton	☐	$12.00—$15.00	$16.00—$19.00	$16.00—$19.00	$25.00—$38.00
Sheraton-Atlantic	☐	$8.50—$14.00	$13.00—$18.00	$14.00—$18.00	$22.00—$38.00
Statler Hilton (Headquarters hotel)	☐	$8.50—$14.00	$11.00—$18.00	$15.00—$24.00	$36.00—$65.00

DESIRED ROOM RATE $	SECOND-CHOICE HOTEL	THIRD-CHOICE HOTEL

YOUR NAME	ARRIVAL DATE	ARRIVAL TIME AM PM	DEPARTURE DATE

COMPANY	STREET	CITY	STATE

NAMES OF PERSONS SHARING ROOM

1. _____ ARRIVAL DATE_____ ARRIVAL TIME_____ AM PM

2. _____ ARRIVAL DATE_____ ARRIVAL TIME_____ AM PM

Mail to: ADVANCE REGISTRATIONS, ASTME, 10700 PURITAN, DETROIT 38, MICH. ADVANCE REGISTRATIONS NOT ACCEPTED AFTER MAY 1. THEN REGISTER AT CONFERENCE OR EXPOSITION ONLY.

CONFERENCE AND EXPOSITION REGISTRATION (ASTME members $1.00—others $2.00)	NO.	TOTAL	LADIES' ACTIVITIES	NO.	TOTAL
		$			
Honor Awards Dinner ($8.00)		$	Getting To Know You (Free)		
Eli Whitney Luncheon ($6.00)		$			
Annual Banquet ($10.00)		$	Ship Ahoy ($2.00)		$
Surface Metrology Seminar (ASTME members $45.00—others $60.00)		$	New York, N. Y. ($3.25)		$
Numerical Control Techtour (ASTME members $3.00—others $5.00)		$	United Nations ($2.50)		$
High-Energy Metalworking Techtour (ASTME members $3.00—others $5.00)		$	Anchors Aweigh ($3.00)		$
Material Removal Progress Symposium (ASTME members $3.00—others $5.00)		$	Design-o-Rama ($2.75)		$
Manufacturing Operations Management Techtour (ASTME members $3.00—others $5.00)		$	TOTAL REMITTANCE		$
Plant Tours ($2.00 each—circle numbers of tours desired below) 1 2 3 4 5 6 7 8 9		$	Please send me free order blank for conference papers ☐		

NAME	COMPANY	PRODUCT

TITLE	STREET	CITY	STATE

NAME OF BENEFICIARY (for free insurance)	RELATIONSHIP	ARE YOU AN ASTME MEMBER? YES ☐ NO ☐

Make checks payable to The American Society of Tool and Manufacturing Engineers.

MAKE HOTEL RESERVATIONS NOW!

Some of New York's finest hotels are holding blocks of rooms for Engineering Conference and Tool Exposition registrants.

To make sure you have good accommodations, clip and fill out the above coupon.

Your reservation will be quickly confirmed by the Bureau.

Headquarters for the Engineering Conference will be in the Statler Hilton Hotel. The Technical Sessions, the Surface Metrology Seminar and the Material Removal Progress Symposium will be held at the Statler Hilton Hotel.

Note: Every effort will be made to see that you have the type of accommodations

SAVE TIME IN NEW YORK! REGISTER NOW!

With this handy coupon, you can register in advance for the Engineering Conference and Tool Exposition without waiting in line. Your Time Saver Badge will be sent to you promptly.

An added bonus—if you register before May 1, you will receive a $10,000 life insurance policy* free!

The coupon can also be used to make reservations for all special events and special features of the Technical Program.

*This death and dismemberment policy, issued by the Bankers Life and Casualty Company of Chicago, will give 24-hour-a-day protection to early registrants. It provides coverage while on a trip to, while there and while returning from the ASTME Engineering Conference and Tool Exposition. Any member or guest

Note: Every effort will be made to see that you have the type of accommodations you desire in the hotel of your choice. If your first-choice hotel is filled, it may be necessary to reserve a room for you in your second-choice or third-choice hotel.

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General Information '61

REGISTRATION

Advance registration—using the coupon provided elsewhere in this Productivity Program—will save you time and trouble in New York. Or you can register at conference headquarters on the west end of the first mezzanine foyer of the Statler Hilton Hotel on Sunday, May 21 (4 to 8 pm); Monday, May 22 through Thursday, May 25 (7:30 am to 3 pm); and Friday, May 26 (7:30 to 10 am). You can also register at the Tool Exposition registration center in the New York Coliseum during exposition hours. The registration fee is $1.00 for ASTME members, $2.00 for others. This fee covers admission to the Tool Exposition and to most technical program sessions. Exceptions are noted elsewhere in this program.

TOOL EXPOSITION

The Tool Exposition will be at the New York Coliseum. Literally thousands of products of interest to tool and manufacturing engineers and manufacturing executives will be shown.

Visitors are encouraged to bring their manufacturing problems to the Exposition. Hundreds of experts on all phases of manufacturing are prepared to demonstrate how these problems can be solved.

TECHNICAL PAPERS

Over 50 papers will be presented at technical sessions during the course of the Engineering Conference. These will cover surface metrology, operations research, numerical control, high energy rate forming, electrolytic metal removal, manufacturing operations management and other key subjects.

TECHTOURS, PLANT TOURS

Techtours combine engineering discussions with a plant tour to see the operations discussed. There will be three Techtours—one to Republic Aviation Corp., one to International Business Machines Corp. and one to Grumman Aircraft Engineering Corp. Advance reservations are necessary. The fee for each Techtour is $3.00 for ASTME members, $5.00 for others.

Electrolux Corp., Ford Motor Co., Fred Heinzelman & Sons, Pitney-Bowes, Inc., American Machine & Foundry Co., Lycoming Div. of Avco Corp., International Business Machines Corp., and Adamas Carbide Corp. A $2.00 charge is made for round-trip bus transportation. Advance reservations are advisable.

SURFACE METROLOGY SEMINAR

This is a two-day program featuring twelve engineering discussions on surface specifications, surface measurement techniques and future developments in this field. Advance registration is necessary. The fee is $45.00 for ASTME members, $60.00 for others. This fee includes registration for the Engineering Conference and Tool Exposition.

MATERIAL REMOVAL PROGRESS SYMPOSIUM

A one-day workshop devoted to new developments in metal removal. Participants will have an opportunity to discuss metal-cutting problems with experts. Advance registration is necessary. The fee is $3.00 for ASTME members, $5.00 for others.

SPECIAL EVENTS

Many special events are planned. These include a Public Affairs Forum in which a panel of experts will compare Russian and American manufacturing industries, and yearly ASTME functions—the Honor Awards Dinner, Eli Whitney Luncheon, Annual Banquet Party, and ladies' activities. These are described elsewhere in this Productivity Program. Tickets can be purchased by mail for these events—use the advance registration coupon in this program—or they can be purchased at conference headquarters.

HOTEL RESERVATIONS

Advance hotel reservations are advisable. These can be made through the ASTME Housing Bureau, using the coupon in this

LADIES' ACTIVITIES

A ladies' headquarters and lounge will be maintained in the Hartford Room on the first mezzanine floor of the Statler Hilton Hotel. Ladies may register (at no charge) with their husbands. Special ladies' activities are planned for each day—Monday through Friday.

Suits are usually worn in New York in May—it is not warm enough for cottons. For outdoor wear, a suit with a light coat is sufficient.

HONOR AWARDS DINNER

Announcement and Presentation of Six
ASTME National Honor Awards

Progress Award
Robert G. LeTourneau, founder and president
R. G. LeTourneau, Inc.

Gold Medal
Dr. Leo P. Tarasov
Research and Development
Norton Company

Joseph A. Siegel Memorial Award
Albert Marden Sargent, owner
A. Sargent Consulting Engineer

Engineering Citation
John Finlay, retired

Education Award
Lawrence E. Doyle, professor
Mechanical Engineering
University of Illinois

Research Medal
Dr. William W. Gilbert, manager
Machinability Development Service
General Electric Company

Dinner: $8.00 — Saturday, 7:30 pm
Statler Hilton Hotel — Grand Ballroom

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The nine plant tours include visits to Brooklyn Navy Yard,

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Statler Hilton Hotel — Grand Ballroom

A Productive Week...

MONDAY, MAY 22

Exposition hours: 1:00 pm—9:00 pm

7:30 am Canadian Chapter Breakfast
8:15 am Surface Metrology Seminar registration
9:30 am Technical Session—Recent Tool and Manufacturing Developments
10:30 am Ladies' Activity—Getting to Know You
12:00 Eli Whitney Luncheon
1:00 pm Ladies' Activity—Ship Ahoy!
1:00 pm Tour 1—Brooklyn Navy Yard
2:30 pm Technical Session—Operations Research

TUESDAY, MAY 23

9:15 am Technical Session—Press Tooling Progress
9:30 am Technical Session—Grinding
1:00 pm Tour 4—Fred Heinzelman & Sons, Inc.
1:00 pm Ladies' Activity—New York, New York
2:00 pm Public Affairs Forum—Race for Manufacturing Supremacy
2:00 pm Technical Session—Automation and Numerical Control

WEDNESDAY, MAY 24

Exposition hours: 9:00 am—6:00 pm

8:00 am Techtour—High-Energy Metalworking (Long Island

THURSDAY, MAY 25

Exposition hours: 9:00 am—6:00 pm

8:30 am Tour 7—Lycoming Div., Avco Corp.
8:30 am Tour 8—Poughkeepsie plant, IBM Corp.
9:00 am Techtour—Manufacturing Operations Management
9:15 am Technical Session—Workholding Developments
9:30 am Technical Session—Appraising the Manufacturing System
12:00 Educators' Luncheon-Conference
12:45 pm Ladies' Activity—Anchors Aweigh
1:00 pm Tour 9—Adamas Carbide Corp.
2:00 pm Technical Session—Cutting Tool Materials
2:30 pm Technical Session—Material Removal

TUESDAY, MAY 23

Exposition hours: 1:00 pm—9:00 pm

8:30 am Tour 2—Electrolux Corp.
8:30 am Tour 3—Ford Motor Co.
8:30 am Techtour—Manufacturing with Numerical Control Systems
9:00 am Tour 3a—Ford Motor Co.
9:00 am ASTME Board of Directors Meeting
8:00 am Techtour—High-Energy Metalworking (Long Island Day)
8:30 am Tour 5—Pitney-Bowes, Inc.
8:30 am Tour 6—American Machine & Foundry Co.
9:00 am ASTME Board of Directors Meeting
9:15 am Symposium—Material Removal Progress
9:30 am Technical Session—Powder Metallurgy
10:00 am Ladies' Activity—United Nations
2:15 pm Technical Session—Numerically Controlled Machining
6:30 pm Social Hour and ASTME Annual Banquet
2:00 pm Technical Session—Cutting Tool Materials
2:30 pm Technical Session—Material Removal

FRIDAY, MAY 26

Exposition hours: 9:00 am—6:00 pm

9:00 am Technical Session—Tracer and Numerical Control Systems
9:30 am Technical Session—Tool Engineering Progress
10:00 am Ladies' Activity—Design-O-Rama

Monday, May 22

'61

Tool Exposition Hours: 1:00 pm—9:00 pm

SPECIAL EVENTS

Canadian Breakfast. Sponsored by the ASTME chapters of Canada for Canadian members and visitors and their guests. TIME: 7:30 am. PLACE: Dartmouth Room, Statler Hilton Hotel.

Fifth Annual Eli Whitney Memorial Lecture. Speaker: Wallace E. Brainard—chief engineer, Servo Machine Tool Div., Kearney & Trecker Corp. Subject: "Put the Skill in the Machine." TIME: 12:00 noon. PLACE: Grand Ballroom, Statler Hilton Hotel. TICKET: $6.00.

PLANT TOUR

Brooklyn Navy Yard (Tour 1). Visit to aircraft carrier Constellation and to the machine shop, sheet-metal shop and welding shop. Extra-large work is handled in all of these shops. Visitors must be U. S. citizens. No cameras permitted. TIME: 1:00—5:00 pm. Buses depart from the Statler Hilton Hotel, return to the Coliseum. TICKET: $2.00.

TECHNICAL SESSIONS

Recent Tool and Manufacturing Developments. Chairman: Julius Schoen—president, Arista Design & Process Corp. TIME: 9:30—11:30 am. PLACE: East Room, Statler Hilton Hotel. Topics:

"Fiber Optics—New Twists in an Old Science" (Paper 368) by Stephen M. MacNeile—director of research, American Optical Co.

"Effect of Catalyst Variations on the Bonding Properties of Epoxy Adhesives" (Paper 367) by Kenneth W. Carroll—manager, technical service, Rubber and Asbestos Corp.

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"Case Study in Operations Research Manufacturing" (Paper 371) by Gerald J. Demirjian—operations research analyst, Touche, Ross, Bailey & Smart.

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"Controlling Surface Finishes with Interferometers" (Paper 341) by Erwin G. Loewen—head-metrology research, Bausch & Lomb, Inc.

Surface Measurement. Chairman: Harry B. Randall, Jr.—branch manager, Pratt & Whitney Machine Tool Co. TIME: 2:30—4:30 pm. Topics:

"The Application of Stylus Inspection Methods in Ball and Bearing Manufacture" (Paper 346) by Dale A. Cue—quality manager, Hoover Ball and Bearing Co.

"The Use of Precision Surface Finish Comparison Specimens" (Paper 345) by Frank R. Bottomley—Fairfield Development Laboratories, Inc.

Problem Clinic: Registrants can discuss individual measurement problems at this session. TIME: 7:30—9:00 pm.

LADIES' ACTIVITIES

Getting To Know You. Initial get-acquainted party. TIME: 10:30 am. Place: Hartford Room, Statler Hilton Hotel. No charge. Coffee and sweet rolls will be served.

Ship Ahoy. A tour of Brooklyn and the Brooklyn Navy Yard. Visit to an aircraft carrier. Walking shoes recommended. No luncheon stop. TIME: 1:00—5:00 pm. TICKET: $2.00.

Tuesday, May 23

Tool Exposition Hours: 1:00 pm–9:00 pm

'61

SPECIAL EVENTS

ASTME Board of Directors Annual Meeting. All members are welcome. TIME: 9:00 am—5:00 pm. PLACE: Penn Top Ballroom, Statler Hilton Hotel.

"A New and Realistic Look at Grinding Wheel Procedures" (Paper 336) by Carle W. Highberg—head, diamond development engineering, Industrial Diamond Div., Engelhard Hanovia, Inc.

swer questions and discussion problems presented to them by Seminar registrants. Moderators will be announced. TIME: 3:15—4:30 pm.

ASTME Board of Directors Annual Meeting. All members are welcome. TIME: 9:00 am—5:00 pm. PLACE: Penn Top Ballroom, Statler Hilton Hotel.

Public Affairs Forum. "Race for Manufacturing Supremacy." Experts from industry, government and education will give first-hand reports on advances made by Russian technologists and engineers, based on recent visits to Russian manufacturing plants. Russian progress will be compared with our own. TIME: 2:00 pm. PLACE: Columbia University Campus. No charge. Everyone is welcome.

PLANT TOURS

Electrolux Corp. (Tour 2). Stamping, machining, die casting, material handling and finishing operations will be seen in a plant that manufactures vacuum cleaners and floor polishers. TIME: 8:30 am—12:30 pm. Buses start from and return to the Statler Hilton Hotel. TICKET: $2.00.

Ford Motor Co. (Tour 3). Mahwah assembly plant. Visitors will see complete automotive assembly operations. TIME: 8:30 am—12:00 noon. Buses start from and return to the Statler Hilton Hotel. TICKET: $2.00. (Tour 3a, leaving the hotel at 9:00 am and returning at 12:30 pm also covers the Ford Mahwah plant.)

Fred Heinzelman & Sons, Inc. (Tour 4). Visitors will see automatic hardening, quenching, washing, drying and tempering operations in one of the most modern heat-treating plants in the country. TIME: 1:00—5:00 pm. Buses start from the Statler Hilton Hotel and return to the Coliseum. TICKET: $2.00.

TECHNICAL SESSIONS

Press Tooling Progress. Chairman: James L. G. Fitz Patrick—dean, Staten Island Community College. TIME: 9:15—11:15 am. PLACE: West Room, Statler Hilton Hotel. Topics:

"Increased Application of Stress Designed Rule Tooling in Industry" (Paper 353) by Lawrence M. Rheingold—president, and Charles F. Hazzard—vice president, Templet Industries Inc.

"Fabrication of Composite Dies" (Paper 352) by Joseph F. Quaas—vice president-research and manufacturing, Eutectic Welding Alloys Corp.

Grinding. Chairman: Gerald Abbot—general manager, Everard Tap & Die Corp. TIME: 9:30—11:30 am. PLACE: East Room, Statler Hilton Hotel. Topics:

"Those Elusive Millionths" (Paper 333) by Harold S. Sizer—director of design, Brown & Sharpe Manufacturing Co.

Hanovia, Inc.

Automation and Numerical Control. Chairman: Wallace T. Fullenwider—production manager, Austin Electronics Div., the Austin Co. TIME: 2:00—4:00 pm. PLACE: West Room, Statler Hilton Hotel. Topics:

"The Evolution of the Numerically Controlled Machining Center" (Paper 360) by Carl B. Perry—product manager, Industrial Systems Div., Hughes Aircraft Co.

"Economic and Technical Feasibility Analyses for Automation" (Paper 361) by Richard S. White—president, Automation Engineering Laboratory, Incorporated.

SURFACE METROLOGY SEMINAR

This is a continuation of the Surface Metrology Seminar starting on Monday, May 22. See Monday's schedule for details. All sessions are in the Gold Ballroom, Statler Hilton Hotel.

Surface Measurement. Chairman: Fred W. Bechtold—chief engineer, S. S. White Dental Manufacturing Co. TIME: 9:00—10:30 am. Topics:

"The Use of Ultrasonics for the Detection of Discontinuities" (Paper 347) by John E. Bobbin—Branson Instruments, Inc.

"A Measuring System for Displacements of Less Than One Microinch" (Paper 348) by Gardner P. Wilson—chief engineer, Brush Instruments Div. of Clevite Corp.

Surface Specifications in Manufacturing Operations—1 TIME: 10:45 am—12 noon. Topics:

"Equipment Design and Machining Applications for Better Surface Finish" (Paper 349) by Clarence Kooistra—corporate quality manager, Marlin-Rockwell Corp.

"Precision Grinding the Required Surface Finish" (Paper 342) by Richard J. Levi—president and general manager, Electro-Autosizing Machine Corp.

Surface Specifications in Manufacturing Operations—2 Chairman: Jacob H. Sperman—owner, Sperman Metal Specialties. TIME: 1:30—3:00 pm. Topics:

"The Application of Burnishing in Parts Finishing" (Paper 344) by Edwin B. Krause—president, Madison Industries Corp.

"A Preview of Surface Requirements and Specifications for the Future" (Paper 343) by Charles H. Good—plant manager, and Frank W. Kabat—Micrometrical Manufacturing Co.

Open Forum Discussion Period. All speakers will an-

TECHTOUR—MANUFACTURING WITH NUMERICAL CONTROL SYSTEMS

This one-day program combines technical paper presentations, a tour of Republic Aviation Corporation's numerical control facility and a discussion period. The fee is $3.00 for ASTME members and $5.00 for others. This fee covers attendance at all sessions of the Techtour, copies of the engineering papers and round-trip bus transportation between the Statler Hilton Hotel and Republic Aviation Corp. Advance reservations are necessary.

Session "A"—Engineering Papers. Chairman: William M. Rynack—assistant professor of automation, New York City Community College. TIME: 8:30—10:30 am. PLACE: Georgian Room, Statler Hilton Hotel. Topics:

"Auto-Prompt, A Three Dimensional System for Numerical Control" (Paper 358) by Samuel M. Matsa—senior analyst, Mathematics & Applications Dept., Data Systems Div., International Business Machines Corp.

"Planning a Maintenance Program for Numerical Control Equipment" (Paper 356) by James J. Childs—administrator, machinery modernization program, Republic Aviation Corp.

"Numerical Control Retrofit of Machine Tools" (Paper 357) by William B. Johnson—industrial engineer and chairman of the numerical control coordinating committee, Rocketdyne, Div. of North American Aviation, Inc.

Session "B"—Engineering Tour. Visitors to Republic Aviation Corp. will see a complete battery of tape-controlled machines in action—two conventional profilers, two skin mills and a five-axis profiler. Final assembly of an advanced fighter-bomber will also be seen. All persons taking this tour must be U.S. citizens. Buses depart from the Statler Hilton Hotel at 12:00 noon.

Session "C"—Panel Discussions. TIME: 4:40 pm. PLACE: Cornell-Dartmouth Room, Statler Hilton Hotel. The speakers from the morning sessions and engineers from Republic Aviation will answer questions on numerical control.

LADIES' ACTIVITY

New York, New York. Tour covering Times Square, Herald Square, Greenwich Village, the Bowery, Civic Center, City Hall, Lower Broadway, St. Paul's Chapel, Trinity Church and Bowling Green. The trip will also include a walking tour of Chinatown and a guided tour of the Stock Exchange. No luncheon stop. Walking shoes recommended. TIME: 1:00—4:15 pm. TICKET: $3.25.

C. M. Verbiest (seated), of C. M. Verbiest & Associates, explains the insurance benefits that will automatically cover advance registrants for the 1961 ASTME Convention. Looking on are (standing left to right) General Manager Harry E. Conrad, Exposition Manager Leonard Abrams and Will Thierens, representative of Bankers Casualty.

Free Insurance

Sparks Early Registration

THE OLD SAYING about the early bird has a new twist for registrants for the 1961 ASTME Convention in New York, May 22-26. The early registrant gets a free $10,000 accidental death and dismemberment insurance policy that will give him 24-hour protection on the way to, during and returning from the convention.

To qualify for this insurance, a member or nonmember must send his advance registration card and the required registration fee to National Headquarters in Detroit before May 1. Advance registration forms, as well as detailed information on the five-day engineering conference and the multimillion-dollar tool exposition, can be found in the convention "Productivity Program," appearing in the News section of this issue.

When a registration card arrives at Headquarters, the sender is promptly mailed a statement to serve as proof of his insurance coverage. *Only those who register prior to May 1 will be covered by the insurance.*

The individual policies for conventioners are written through Bankers Life and Casualty Co. of Chicago, the same company that underwrites the Society-sponsored group insurance plan for members and their wives.

"Although almost all expositions carry liability insurance to cover accidents at the exhibit, this is the first time any exposition has issued *individual* policies to visitors," said General Manager Harry E. Conrad. It is also a first for Bankers Casualty, according to the agent, C. M. Verbiest of Detroit.

In addition to the $10,000 insurance policy, everyone registering before May 1 will receive a Time-Saver badge which will allow immediate entry to the exposition and to all technical sessions.

New Award Salutes Technical Authors

THE DISTINCTION of being first winner of the Society's newest national award, the "ASTME Outstanding Manuscript Award," will be within the reach of speakers presenting technical papers at the Annual Meeting in New York this May.

In announcing the inauguration of the award, General Manager Harry E. Conrad stated, "Selection of the winning engineering paper will be made by a special committee appointed by the chairman of the National Program Committee, James R. Matthew, Culver City, Calif."

Initial screening will be done by the staff program director and the editor of THE TOOL AND MANUFACTURING ENGINEER.

The manuscripts will be judged on technical excellence, which includes originality and degree to which they advance the scientific and educational progress of tool and manufacturing engineering; technical writing excellence, not literary skill; and aptness of illustrations where illustrations are required. Only those papers received in time for premeeting printing will be eligible for the award.

The winning author will receive a bronze plaque and a letter of recognition and appreciation, over the Society president's signature, sent to the president of the author's company.

"If a truly outstanding national meeting paper is received each year, the award will be bestowed annually," said Conrad. If no outstanding paper is received, no award will be given.

Piedmont Calls Back 'Exported' Engineers

James Bowen (right), Piedmont education committee chairman, presents a $1000 student loan fund to Robert Halstead (left), director of Gaston Technical Institute. Looking on is Piedmont chapter's newly elected chairman, Raymond Monroe, Jr.

PIEDMONT, N. C.—When Piedmont chapter plans a program, they do it up big—judging from their recent Education Night on which "Project—Return of the Native" was launched; a $1000 student loan fund was established; a technical speaker told of the history and current applications of carbide tools; and new chapter officers were elected.

The biggest event on the big program was the chapter's call for the return of native-born North Carolinian engineers to meet the needs of the state's rapidly growing industry. Many trained engineers and skilled workers are needed, say Piedmonters, to staff the new and expanded industries in their chapter area, which contains a major part of the state's new industrial growth.

"Challenging opportunity in their specialized field is the key to bringing back our native engineers and keeping them here," stated Dr. J. Harold Lampe, dean of engineering at North Carolina State College and keynote speaker at the meeting. Outlining a three-point program to bring back the state's "exported" engineers, he told the chapter that a study should be made to show the kind of job opportunities available; that communication among industry, engineering and technical schools, and industrial development organizations should be established; and that both the quality and quantity of industry's technical manpower needs should be recognized.

Another highlight of the evening was Chapter 82's presentation of a $1000 check to Robert Halstead, director of Gaston Technical Institute. The funds will be used to aid students in the field of mechanical and production technology, the institute course most similar to tool and manufacturing engineering.

New chairman of the Piedmont group is Raymond Monroe, Jr. Other officers elected on Education Night are: James R. Huntley, first vice chairman; Frank W. Deitrick, second vice chairman; F. F. Willis, third vice chairman; G. A. Marshall, Jr., secretary; and F. J. Myers, treasurer. —*John Lucas*

positions available

MANUFACTURERS REPRESENTATIVES WANTED—for line of Carbide boring tools. Write to Classified Ads, Dept. 204, 10700 Puritan Ave., Detroit 38, Mich.

MANUFACTURERS REPRESENTATIVES WANTED—in major industrial areas, except Detroit, with good contacts for single-point tools, both solid carbide and carbide-tipped. Top quality-fabricator can offer competitive prices and delivery which will insure profits if you can produce inquiries. Reply to Box 113, 18285 Weaver, Detroit 28, Mich.

MACHINE TOOL SALESMAN WANTED—Prominent manufacturer of machine tools, selling direct to the user, has opening for salesman with contacts in the Brooklyn and Long Island, N. Y., area. Write to Classified Ads, Dept. 202, 10700 Puritan Ave., Detroit 38, Mich.

TOOL DESIGN, MACHINE DESIGN with ME or IE background. Stimulating work and professional development on new, growing campus of two-year college of State University of New York. Accredited by MSA and EDPD. B.S. required; Master's degree and/or teaching experience desirable. Starting salaries to $7500, depending on experience, background, etc. Write full details to Mr. Benjamin Davis, Head, Mechanical Dept., Mohawk Valley Technical Institute, Utica, N. Y.

position wanted

INDUSTRIAL AND TOOL ENGINEER—18 years' experience on tools, jigs and fixtures; also in all phases of industrial engineering such as estimating, processing and liaison. Three years' experience in epoxy encapsulation of various electronic components. Write to Classified Ads, Dept. 203, 10700 Puritan Ave., Detroit 38, Mich.

special events

"Aerospace Manufacturing Technology Seminar"	April 14-15 1961	University of Arizona Tucson, Ariz.
Third Canadian On-Campus Conference "Competitive Manufacturing"	April 15 1961	McMaster University Hamilton, Ont.
ASTME Seminar "Process Planning—Operations Research"	April 18-19 1961	Statler Hilton Hotel Cleveland, Ohio
ASTME Engineering Conference	May 22-26 1961	Statler Hilton Hotel New York City
ASTME 1961 Tool Exposition	May 22-26 1961	New York Coliseum New York City

Space-Age Engineers Launch Chapter

HUNTSVILLE—Alabama recently added Huntsville No. 171 to the ASTME chapter roster. Most of the new chapter's 120 members are engaged in Space-Age manufacturing, either at the George C. Marshall Space Flight Center, an installation of the National Aeronautics and Space Administration, or at other local space engineering firms.

President H. Dale Long officiated at the chartering ceremonies and spoke to the group on the place of the tool and manufacturing engineer in the world of today and tomorrow. Some 130 persons—including National Vice President Frank F. Ford; Ed Ketchie, of the National Membership Committee; and a sizeable delegation from local government, business and industry — turned out to launch the chapter.

Heading Huntsville Chapter 171 is Chairman Charles J. Lannon. Other officers are William R. Pomeroy, first vice chairman; Davis Parsons, second vice chairman; Norman Levine, secretary; and John Evers, treasurer. —*James H. Ehl*

Receiving the Huntsville charter from Society President H. Dale Long (left) is Charles J. Lannon, chairman of the new 120-strong chapter.

Reports in Brief . . .

Midwest

The proposed ST. PAUL chapter will be chartered on April 20 by ASTME National President H. Dale Long. Composed of 81 new and transfer members, the group has already elected temporary officers with Walter Graber as chairman. . . . CLEVELAND chapter recently staged an interesting program on "Cutting Metal and Cutting Cost." Slides illustrating the advantages of ceramics, in comparison with regular carbide or high-speed steel tools, were shown by Robert T. Hook, chief metallurgist at Warner & Swasey Co. He also discussed the machinability of steels, ultimate cutting speeds of steel, and tooling completely with carbide to cut cost. Three past chairmen attended the Cleveland meeting, at which Herb Berg was elected chairman for the new term. . . . National Education Director Gilbert E. Seeley was guest speaker at the first meeting of the DETROIT ENGINEERING INSTITUTE student chapter. . . . In a talk on the relationship of the design and the tool engineer, Sherman C. Heth, vice president in charge of engineering at the Jacobsen Mfg. Co., recently told RACINE chapter members that the proper relationship between the two types of engineers is one of cooperation and joint effort. That same evening the following were elected as chapter officers: Ray Knapp, chairman; Bernard Matter, first vice chairman; Donald Freres, second vice chairman; Carl L. Quadracci, secretary; Robert G. Welch, treasurer.

Northeast

Some 15 toolmakers, tool designers and toolroom superintendents attended the 20-week course in die-design conducted by SOUTHEASTERN MASSACHUSETTS chapter. The course, taught by Karl W. Mittel, chief tool engineer at the Metals & Controls Div., Texas Instruments, Inc., ended in mid-March. . . . Speaking on "Automation and Numerical Control," N. P. Sickich, of Kearney & Trecker Corp., told MONADNOCK chapter of the development and current applications of tape control.

Mexico

Members of MEXICO CITY chapter recently visited Productos Ramcon, one of the largest die-casting plants in Mexico. The group paid particular attention to the modern methods of die casting in use. Four of the die-casting machines were designed and built in the plant itself, all the molds are produced there and a great percentage of the material used in the die-casting process is produced in Mexico. The plant is completely Mexican owned and operated.

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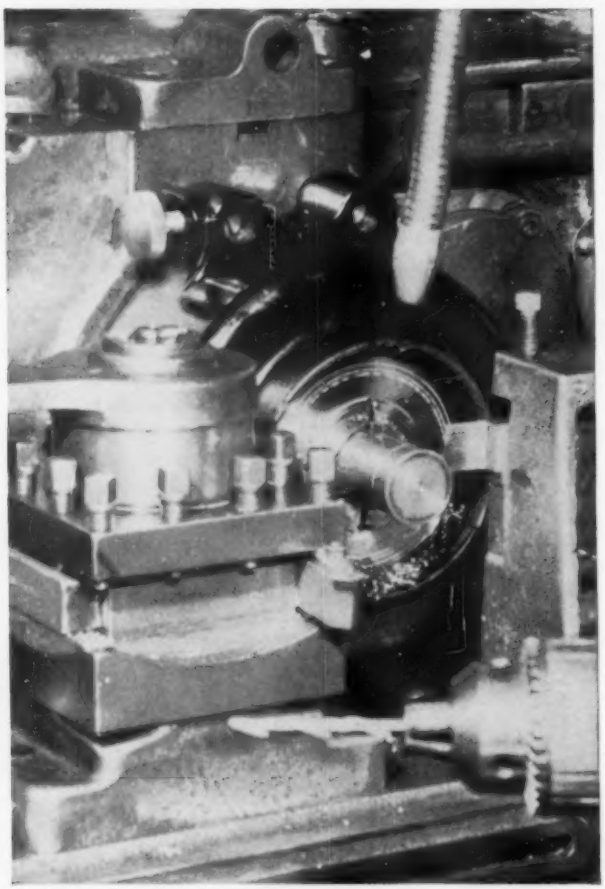
...machines metals at faster sfpm with increased production and longer life than HSS



V-R Tantung holds its cutting edge hardness at temperatures well above those at which HSS "burns up." It has higher shock resistance than carbides. Tantung's high red hardness, high transverse rupture strength and low coefficient of friction make it the ideal tool material for intermediate cutting speeds . . . and it's easy to grind on aluminum oxide wheels of vitrified bond.

*Exclusive V-R Cast Alloy

Comprised principally of cobalt, chromium and tungsten, V-R Tantung is poured from molten metal and cast in chill molds. Rapid solidification imparts high hardness, very fine grain structure and maximum strength. You should use versatile Tantung . . .

- **where higher speeds and feeds are desired than possible with HSS.**
- **for continuous production runs on all types of machines.**
- **where low surface speeds cause build-up on carbide tools.**
- **where machines lack power or rigidity for carbides.**
- **for multiple-diameter machining with carbide or HSS.**
- **for short runs on automatics where carbide is too costly.**

Your V-R distributor stocks Tantung tools. Call him or write V-R today to learn how Tantung can help you.

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CREATING THE METALS THAT SHAPE THE FUTURE

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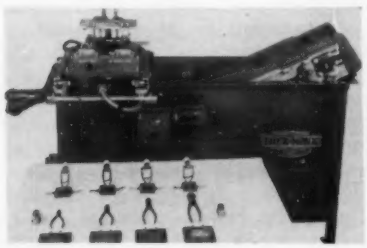
Progress in Production

CONVEYOR SETUP HARDENS PLIERS IN FOUR SECONDS

Two sets of work coils are able to harden four types of diagonal cutting pliers in a new technique that requires only four seconds. First, the pliers are through-hardened by furnace heating to R_C 55-58. Second, they are drawn to R_C 40-45 for toughness. Next comes hardening of the cutting edge to R_C 56-58.

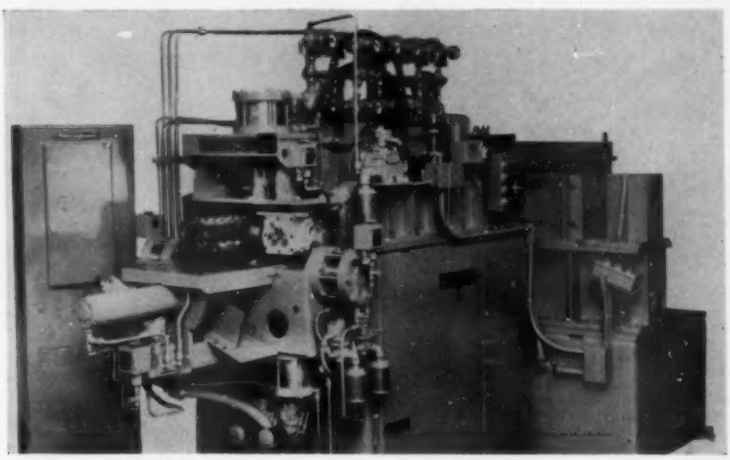


This setup hardens four types of pliers along their cutting edges in eight seconds. Only loading is manual; all other operations are handled automatically by conveyorized equipment.

The tooling required is a flight type unloading conveyor and oil recirculator, 5-kw heating elements for heating the quench oil to the proper quenching temperature of 140 F, a heat exchanger for maintaining oil at the proper temperature, a variable speed drive for the flight unloading conveyor and a 25-kw generator.

The fixture, after it is loaded by pulling back the work coil adapters and placing two pliers on the adapter fixtures, is moved forward. This automatically depresses the start cycle when the fixture reaches the proper position. At the end of the cycle, the adapter tilts down 35 deg by means of an electrically operated solenoid, discharging the two pliers into an oil quench. From the quench tank, the pliers are picked up by the flight conveyor and are transferred to a tote box for further processing. The equipment was designed and built by Induction Heating Corp.

MACHINE FORMS AND WELDS MOTOR SHELLS



Mash seam welder is the main unit of a motor shell fabricating line which forms and assembles 420 parts per hour.

Starting with a stack of slotted steel blanks, a fabricating line, centered around a mash seam welder, forms and assembles a variety of shells used for fractional horsepower appliance motors.

At a rate of 420 parts an hour, cut blanks are fed to a roll forming mill and, after being formed into a cylinder, are shuttled by an air-operated transfer mechanism to the weld station. Air-operated wraparound clamps mold the shell firmly to the welding arbor and carry current as a rocker type, antifriction head mash-welds the seam. The clamps relax and the welded shell is ejected into a discharge chute.

This motor shell welder, built by Precision Welder and Flexopress Corp., Cincinnati, is in use at the Belfontaine, Ohio, Westinghouse Electric Co. plant.

AUTOMATIC PROCESS REPLACES CONVENTIONAL ARC WELDING

Semiautomatic arc welding has been able to substantially increase welding speed over previous hand methods at International Harvester Co.'s Chicago tractor works. Typical welding speed for 5/16-inch fillet welds is 18 ipm.

The Innershield process, developed by Lincoln Electric Co., Cleveland, uses a new type of electrode which, in turn, uses a new principle of shielding. The principle involved in the process is vapor shielding with a tubular, fabricated electrode. The tube provides filler metal and contains materials which furnish all necessary ingredients for shielding, deoxidizing and fluxing. A portion of these are chemically inert metallic salts and oxides which have melting and boiling, or vapor-producing, temperatures lower than those of the electrode metal.

The development of a fast-fill electrode and the design of a welding gun and wire feed mechanism have resulted in a speedier welding process.

When these metallic salts are exposed to the intense heat of the arc, they vaporize and expand. As they reach the isothermal cone surrounding the arc corresponding to their condensing temperature, they recondense forming a relatively thick shield of vapor surrounding the arc and molten metal.

HARD-SURFACING QUADRUPLES SHAFT LIFE

By hard surfacing shafts used in a logging truck brake mechanism, a California plant has extended the service life of new parts from 8 to 18 months

IT'S A FACT

FOR POSITIVE HOLDING OF COMPONENTS IN JIGS AND FIXTURES...

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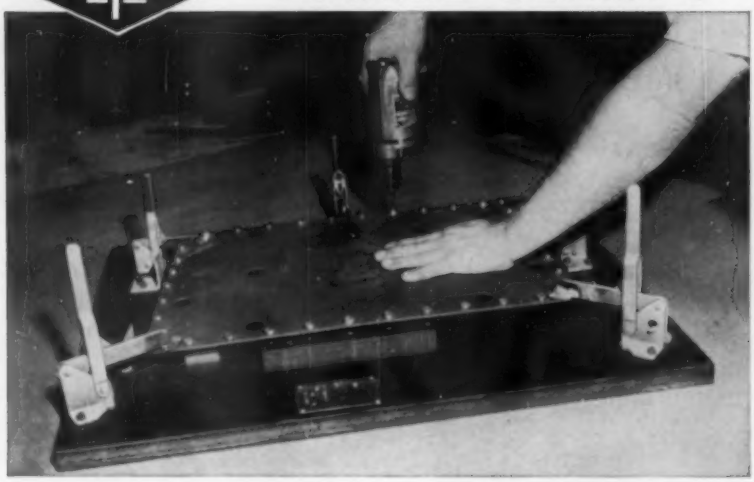

Simple drilling fixture made up of 5 toggle action clamps mounted on a plywood base holds drill bushing plate firmly in position.

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to from 30 to 50 months. The parts are of hardened SAE 1040 steel.

The length of shaft life depends upon the degree of exposure to abrasive grit, sand and mud regularly encountered in the logging operations. New shafts generally begin to show some wear within a few weeks.

Hard chrome plating had been tried in an effort to lengthen service life. This was only partially effective, however, giving only a slight improvement over the original parts. Hard chromed shafts generally began to show wear in about a month and, in the logging truck operation, lasted anywhere from 10 months to 24 months. Furthermore, hard chroming was not an economical method.

Worn shafts are first ground undersize and grit blasted. Colmonoy No. 4 Sprayweld powder—a nickel-base material containing chromium borides as well as chromium carbides—is then applied as the shaft is rotated on a lathe. The powder, picked up from a hopper, is propelled by compressed air through the pistol and, from the pistol nozzle, through an oxyacetylene flame in a narrow cone pattern, which insures optimum deposit efficiency. The sprayed deposit is 0.030-inch thick.

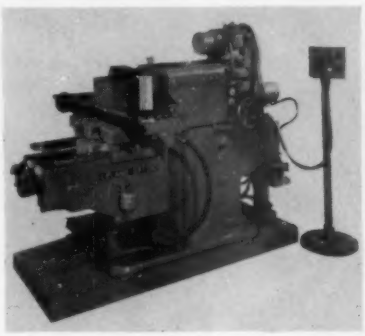
Shaft, overlaid with a hard-surfacing powder, has increased abrasion, corrosion and galling resistance.

To this point, the operation is much like metallizing. The next step is that, with the shaft still rotating in the lathe, the powder is welded to the shaft by application of a conventional oxyacetylene torch. This fusing operation produces a molecular bond between the alloy and the steel base metal. Finish grinding to original equipment dimensions completes the hard-surfacing operation. The operation is at Consolidated Machine & Tool Co., Oroville, Calif.

TOOLS of today

Knee Type Gun Drill Has High Speeds

Designed for drilling deep holes in ferrous or nonferrous materials with carbide tipped drills, this knee type gun drill uses either a self-contained hydraulic feed or a leadscrew feed gun drilling unit. The knee type setup eliminates expensive fixturing when a varity of work is to be gun drilled by coordinate elevating, traversing and swiveling of the table. Recommended for drilling accurate holes up to $\frac{5}{8}$ inch in diameter by 7 inches deep, the self-contained hydraulic feed unit offers uniform feed rates and simple feed rate changing. The pump and spindle are independently powered with a $1\frac{1}{2}$-hp, totally enclosed spindle motor driving through a timing belt drive. For general use, variable speed drives are available for speeds to 10,000 rpm. For holes having depth greater than 7 inches, an electro-mechanical gun drill unit can be furnished with 12, 24, or 36-inch stroke.



Driven by a $1\frac{1}{2}$-hp motor through a nonslip timing belt, the spindle can be run at speeds from 720 to 12,000 rpm with a 3600-rpm motor or at 360 to 6000 rpm with a 1800-rpm motor. Feed is actuated by and synchronized to the spindle speed and can be changed through pick-off gears from a minimum of 0.00019 ipr to a maximum of 0.0015 ipr in increments of 0.000015 inch.

Leland-Gifford Co., Worcester 1, Mass. **Circle 401**

Profile Grinder Handles Contours, Irregular Shapes

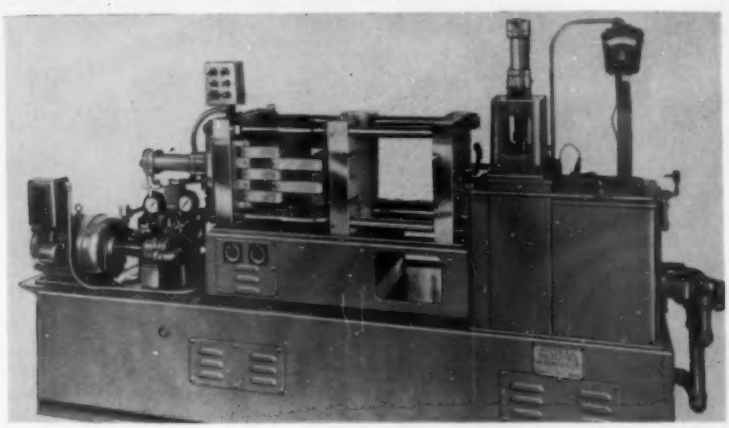
Suited to work in tool and die shops, toolrooms and low-production operations, the No. 3 floor type, tilting table profile grinder for grinding and polishing contours and irregular shapes has

a grinding wheel mounted on a vertical reciprocating spindle. The grinding wheel is in the center of a counterweighted 18-inch-diam round worktable that is accessible from all sides. Reciprocating action of the grinding wheel promotes wheel life and prevents shoulders from forming on the wheel.

To grind a contour on a part, the vertical slide-mounted table is unlocked, raised with a capstan handwheel and locked to bring the part in correct vertical contact with the reciprocating grinding wheel. The part is then moved on the table around the wheel by hand to bring the desired work areas into wheel contact. Pencil and cup type grinding wheels up to 4 inches in diameter can be used on the machine.

The machine has wheel speeds of 4500, 6500 and 10,150 rpm. Total wheel reciprocating is $\frac{5}{16}$ inch. The wheel

Redesigned Die Caster Doubles Output



With a hydraulic combination pump which delivers 21.8 gpm, the previous possible output of die castings made by the Model 150Z, 150-ton locking pressure die casting machine is doubled. The machine will complete 1300 free cycles per hour or a complete cycle in 2.8 sec. This development uses valving which allows the regulation of pressures between the clamping cylinder and the shot cylinder to be isolated from each other. The safety shot die interlock has also been redesigned for greater safety to operators from molten metal dangers.

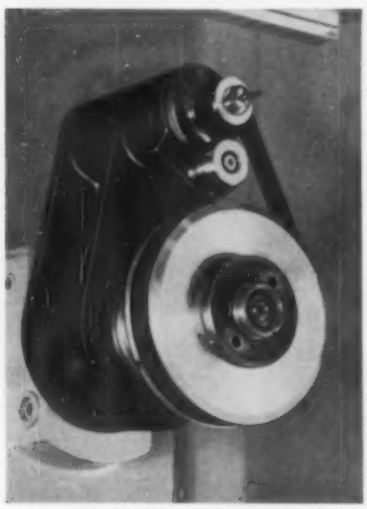
American Die Casting Machinery Co., Chicago 40, Ill. **Circle 402**

makes 90 reciprocations per minute. A 1½-hp motor powers the grinder which occupies a 24 x 30-inch floor area.

Star Cutter Co., P. O. Box 376, 34500 Grand River Ave., Farmington, Mich. **Circle 403**

Grinding Attachment for Hard-to-get-at Areas

Designed for use on hard-to-reach areas where surface grinding is desired, the Diamond Speedgrind attachment is available in various models to fit most surface grinders. A slipless belt tension adjustment eliminates strain on the



bearings and the belt contacts 65 percent of the driven pulley's surface. The body of this unit is an alloy casting with all unnecessary bulk eliminated to enable the operator to get closer to the chuck. The unit is available with 3/32, 1/8, 5/16 or 1/4-inch collets or a mandrel for 1/4 or 3/8-inch ID wheels. Recommended wheel diameters are 3/32 to 1½ inches.

Speedline Sales Co., 12860 Fisk Ave., Warren, Mich. **Circle 404**

Form, Shave Tool Blanks In Standard Sizes

Approximately 40 items comprise this line of form and shave tool blanks. This represents a complete range of sizes in dovetail tools and also provides a choice of either soft blanks or hardened and ground blanks as well as a choice of high speed steels. By using these blanks, the machine and toolmaker's time normally required to prepare blanks for grinding is eliminated.

Somma Tool Co., 109 Scott Rd., Waterbury, Conn. **Circle 405**

Device Measures Machine Motion

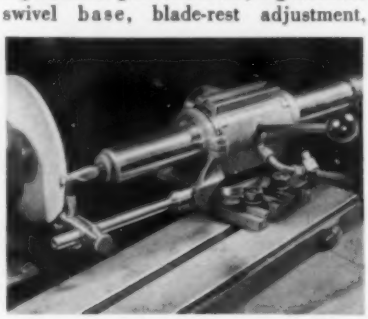
Providing continuous indication of carriage, slide or tool position in relation to workpiece within 0.001 inch, the Trav-A-Dial indicator is a useful instrument in production shops and toolrooms. Attached to any machine tool with a special spring loaded mount and a fabricated bracket, it makes measurements by a gage wheel contacting a way or machined surface. Motion is transmitted through two precision gear trains to a dial indicator reading in

thousandths which is equipped with a bezel for instant zero adjustment. A dial knob, graduated in inches and 0.1 inch, gives a continuous motion record up to 6 inches of travel. The dial contains a built-in slip clutch which permits full zeroing adjustments without disengaging the gage wheel from its contact surface. The device can be used on toolroom and engine lathes for making lineal measurements and for insuring locating accuracy on horizontal and vertical mills, radial drills and grinders.

Southwestern Industries, Inc., 5880 Centinela Ave., Los Angeles 45, Calif. **Circle 406**

Cutter Sharpener Has Floating Spindle

One feature of the Air-Flo fixture —an end mill and milling cutter sharpening fixture—is that it has a spindle that floats on an air cushion less than 0.00015-inch thick. The fixture also has a graduated goose-neck tilt, a graduated swivel base, blade-rest adjustment,



chromium inlay and indexes and components to grind tapered end mills as well as straight. It speeds sharpening of end mills, routers and virtually all types of milling cutters. The flow of air inhibits the entrance of grinding dust and simplifies sharpening tools as small as 1/32 to 1¼-inch shank capacity. With this fixture, any style cutter with a diameter to 6 inches can be sharpened.

Harig Mfg. Corp., 5757 W. Howard St., Chicago 31, Ill. **Circle 407**

Small Relay Saves Space

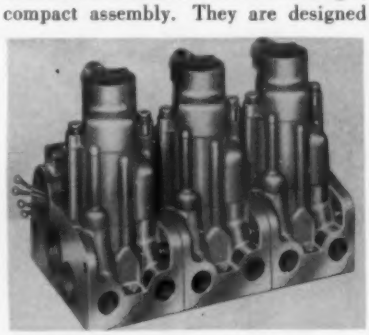
Designed specifically for the automated machine tool industry, the Type BF relay saves as much as 50 percent control panel space. Measuring 3⅛ x 1 11/16 inches, it occupies an area about the size of a cigarette lighter.

Its clamp type terminals have a wire stop and accept solid or stranded wire ranging in size from No. 14 to 18. Rated full load current is 6 amp at 300 volts a-c. Operating time is 12.5 to 18.0 millisecond on pickup and, on drop-out, 6.25 to 12.5 millisecond. For prolonged circuit continuity, the contacts have a slight wiping action when mating.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa. **Circle 408**

Manifold Bases Simplify Piping, Wiring

Because they meet JIC standards and have common supply, exhaust and wiring conduit ports, these modular manifold bases can be ganged end-to-end to manifold two or more valves in a single, compact assembly. They are designed



for mounting ½-inch control valves.

The modular manifold base is cast aluminum. Cylinder ports are side and bottom tapped, 3/8, ½ or ¾ inch NPT. The supply port is tapped on both ends and bottom, 1 inch NPT, while the exhaust and wiring ports are tapped 1¼ inch NPT, both ends and bottom. Each valve has a junction box opening into the wiring conduit to simplify electrical hookup at original installation. Capscrews and O-ring seals are furnished.

Hunt Valve Co., 1913 E. State St., Salem, Ohio. **Circle 409**

For More Putnam Tool Information, CIRCLE 65

This NEW Catalog

. . . lists the country's most complete line of end mills

PUTNAM
MITEE-MITE MILLS
SHORT TWO FLUTE DOUBLE END MILL
Hollow Ground Spiral Flutes
TWO FLUTE DOUBLE END MILL
Hollow Ground Spiral Flutes
SHORT TWO FLUTE SINGLE END BALL MILL
Hollow Ground Spiral Flutes
TWO FLUTE SINGLE END BALL MILL
Hollow Ground Spiral Flutes
Hi-Speed
PUTNAM END MILLS
SHORT FOUR FLUTE DOUBLE END MILL
Hollow Ground Spiral Flutes
Right hand cut and spiral
FOUR FLUTE DOUBLE END MILL
Hollow Ground Spiral Flutes
Right hand cut and spiral
LEFT-HAND SPIRAL RIGHT-HAND CUT SINGLE END MILL
Hollow Ground Spiral Flutes
LEFT-HAND SPIRAL RIGHT-HAND CUT LONG END MILL
Hollow Ground Spiral Flutes
EXTENSION TYPE TWO FLUTE SINGLE END BALL MILL
Hollow Ground Spiral Flutes
HEAVY DUTY SMELL END MILL
DOVETAIL CUTTERS 45° Angle
DOVETAIL CUTTERS 60° Angle

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THE BOOK DESIGNED TO FIT ANY TOOL BOX

Over 1800 Standard Types & Sizes of Putnam End Mills

Now! You can order standard end mills ranging in diameter from 1/32″ to 6″ and get off-the-shelf delivery. In the Putnam line of over 1800 standard types and sizes are many end mills that are considered as "specials" by other manufacturers.

Regardless of your requirements, there probably is a Putnam standard end mill that will exactly meet your needs. You can get all the superior Putnam cutting qualities for milling: intricate shapes, deep cuts, tough materials, aluminum, etc. – without purchasing costly specials.

Contact your local Putnam Distributor, he will recommend the best end mill for each specific job and give you quick delivery from his stock.

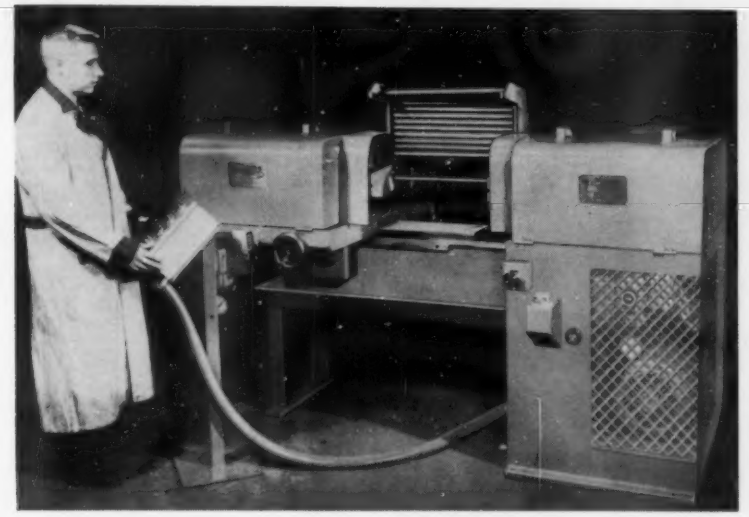
(Please write on your company letterhead)

A plant that specializes in the manufacture of end mills

Putnam end mills are made by specialists who work in a modern plant having the finest equipment available. Every end mill is machined from high speed steels of rigid Putnam analysis, heat-treated in our own plant and produced under close quality control. Because *end mills are our business,* we carefully guard their reputation for quality and performance with individual inspection on a score of important details.

DISTRIBUTORS
IN CITIES
COAST TO COAST

Machine Finishes 1500 Double-End Parts an Hour

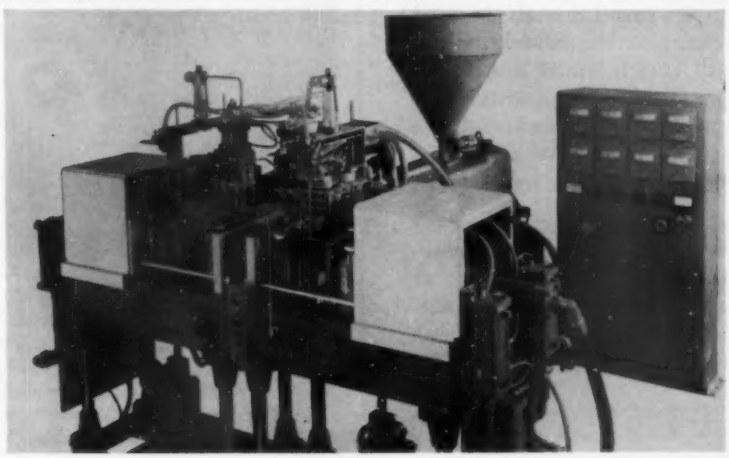


Both ends of tube, rod, pipe or similar workpieces having diameters to 3 inches and lengths to 120 inches can be finished simultaneously with the Model 666 machine. Performing operations such as inside and outside deburring, chamfering and facing, it produces from 2400 to 3000 finished ends an hour.

Workpieces are automatically fed into machining position by the hydraulically actuated feed mechanism. Through the use of controlled hydraulic operation and positive depth-of-cut stops, length tolerances are held within 0.005 inch on a production basis. While minimum workpiece length is 5 inches, adapters are available to accommodate work as short as 2½ inches. The machine can also be used for chamfering or pointing solid stock with diameters as small as ¼ inch, producing common chamfer angles up to ⅛-inch maximum width cut. The machine consists of the base and stationary head, the machine bed and the movable head.

Pines Engineering Co. **Circle 410**

Molding Machine Has Building Block Construction



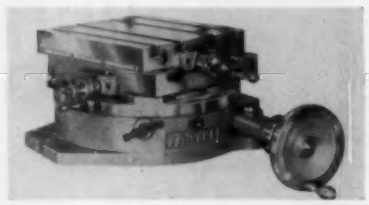
Each of the 10 different models of the Versa-Blow molding machine has three-way micropositioning adjustment for centering the mold under the parison head. Each press also has positive, high-speed equalized opening and closing, insuring accurate mold alignment.

The machine has a self-cleaning, high-speed, horizontal, in-line accumulator. Three separate head adjustments regulate parison weight, concentricity and straightness. To accommodate dies of various thickness without shimming, the platen daylight opening is adjustable. With modular building-block construction, the machine offers a virtually unlimited range of combinations to suit various production requirements.

Plastics Machinery Div., Producto Machine Co., 990 Housatonic Ave., Bridgeport 1, Conn. **Circle 411**

Unit Combines Rotary Table, Cross Slide

This unit is a combination cross slide and rotary table built into one unit for X, Y and rotary positioning. It has a



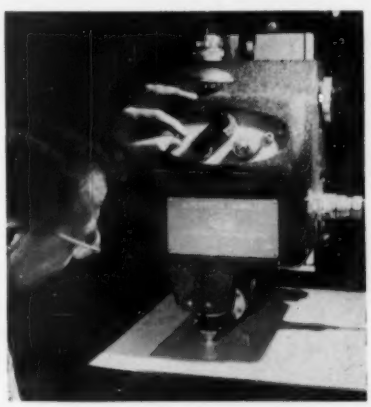
12 x 12-inch working surface with 10 inches of travel. Accuracy is 0.001 inch in the full length of cross slide travel. Other features of Model DMT-15 include adjustable tapered gibs; cross slide dials graduated in 0.1-inch increments; and a rotary table dial graduated in 1-min increments.

Troyke Mfg. Co., Cincinnati 41, Ohio. **Circle 412**

Electronic Tracer Uses Drawing Templates

Suited for cutting work of a non-repetitive type, the Aircotron Model J electronic tracer—because it uses templates prepared by conventional drafting methods—cuts the cost of the templates and finished work. It provides stepless cutting speed control and tracing of 90-deg corners without corner radii. The unit can also be used for chain cutting.

The tracer consists of the scanning head and control, the control panel mounting bracket and the raise-lower device. It uses a small light-sensitive element located in the scanning head to



follow the template line of the part to be cut. Width of the line must be maintained between 0.020 and 0.040 inch. The tracer is not affected by conditions such as extraneous light.

SELF-THINNED HEAVY DUTY DRILLS*

eliminate web thinning operations

National

Self-thinned Heavy Duty Drills, now available with straight shanks, as well as with taper shanks, give improved drilling performance and longer life on all tough, hard metals. A patented, pre-thinned web design eliminates manual web thinning operations when resharpening . . . throughout the useable life of the drill! Absolute centrality of the web-thinned portion is thus guaranteed; surface-treated cutting faces remain intact.

Self-thinned Heavy Duty Drills by National are real 'cost-cutters' on hard-to-machine materials such as stainless and alloy steels, armor plate, hard cast iron and high temperature alloys. Call your local National Distributor for these tools with the famous *plus*.

NATIONAL TWIST DRILL & TOOL COMPANY

Rochester, Michigan, U.S.A.

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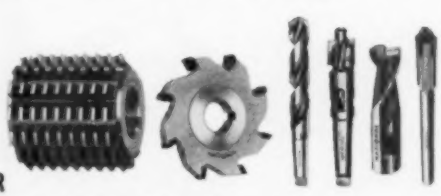
*Just One of National's Parade of Plus Products



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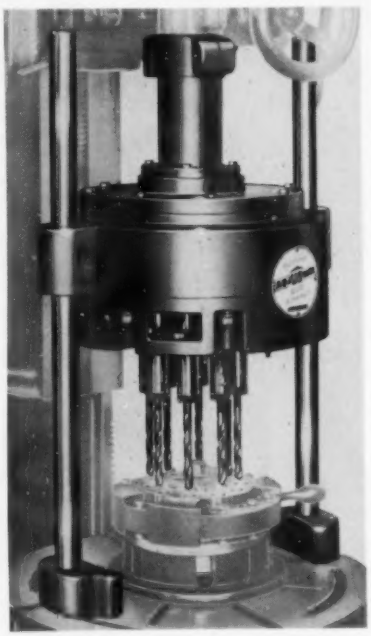
TOOLS of today

Mounted on the operating bar of the cutting machine, the tracer head provides the desired motion of the torches during the cutting operation. It has a range speed from 5 to 24 inches and uses 115-volt, 50-cycle, single-phase current at 5 amp.

Air Reduction Sales Co., Div. of Air Reduction Co., Inc., 150 E. 42nd St., New York 17, N. Y. **Circle 413**

Multiple Spindle Head Fits Standard Drills

Actually a fixed center type multiple spindle drill head, the Adjustafix is readily installed on standard or special machines. It adds flexibility for drilling, tapping, reaming, spotfacing, boring,



counterboring and milling operations. It consists of a main drive box and a demountable pattern plate. When changing to another job, only the pattern plate is changed and the spindles and idlers are relocated on the new pattern plate to conform to the new design. Because spindle and idler construction are entirely separate self-contained assemblies, exact tool speed required for a given job is possible without changing the gearing in the main drive box.

United States Drill Head Co., 5298 River, Cincinnati, Ohio. **Circle 414**

USE READER SERVICE CARD ON PAGE 135 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Tap Holders Have Self-Feed Feature

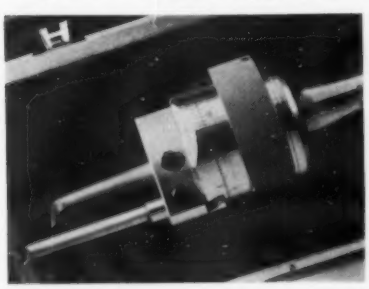
These self-feeding tools can be used as either releasing or nonreleasing tap holders on all machines with reversing spindles. They convert, in effect, any machines on which they are used into

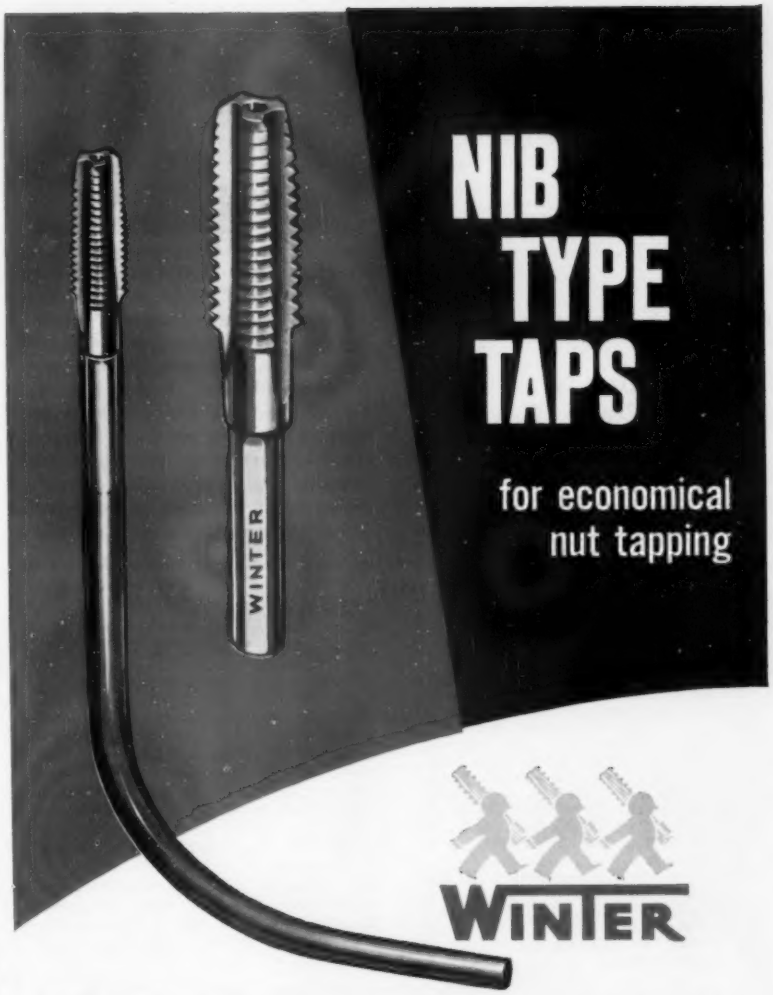
tapping machines. The length of pull-out for releasing can be varied from a minimum of 1/16 inch to a maximum of 3/4 inch by adjustment of the knurled depth control collar. Designed so the major diameter does not exceed the shank diameter, the entire length of these tap holders will fit in the tool holder opening of the machine turrets. They are available in several capacities: 5/8-inch diameter from No. 0 to No. 12; 1-inch diameter from No. 0 to 1/2 inch; and 1 1/4-inch diameter from No. 10 to 5/8 inch.

Tapmatic Corp., 845 W. 16th St., Costa Mesa, Calif. **Circle 415**

Boring Head Has Vernier Markings

This boring head set has a practical size for every type of machine. The round adjusting collar, which is geared to the leadscrew with a 2:1 ratio, is graduated around the full 360 deg providing micrometer-like markings, generously proportioned so that size changes may be made from any position and easily read. The round design permits





Winter Brothers' Nib Taps with *Balanced Action* offer greater production economy on automatic nut tapping operations than conventional one-piece tapper taps. When the tap becomes worn, only the nib section itself requires replacement. Nibs are easily assembled to the shank by brazing or sweating, butt welding, or by means of spline-drive or threaded connections.

Investigate the cost-cutting possibilities of Winter Brothers' Nib Taps. They're available in a complete range of thread sizes in either bent- or straight-shank design for tapping a wide variety of materials.

WINTER BROTHERS COMPANY
Rochester, Michigan, U.S.A.

DISTRIBUTORS IN PRINCIPAL CITIES. BRANCHES IN NEW YORK
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Choose from
Winter's Wide Line of
Taps, Dies and Gages

CALL YOUR WINTER DISTRIBUTOR

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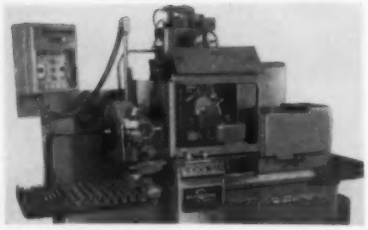
higher speed, without vibration. The vernier permits adjustments to 0.0001 inch. Each tool block has two end holes for cutters—one on and one off-center—and a through cross hole. They are available in four standard sizes taking cutting tools of ½, ¾, 1 and 1¼-inch diameters, and with work ranges to 20 inches in diameter.

Maxwell Industries, Inc., 493 E. Fifth St., Ashtabula, Ohio. **Circle 416**

Machine Grinds External Crown Gears

Developed for use on the teeth of spherical gear type couplings, the Model CGG-16 x 18FA crown gear grinder can also be used to grind spur

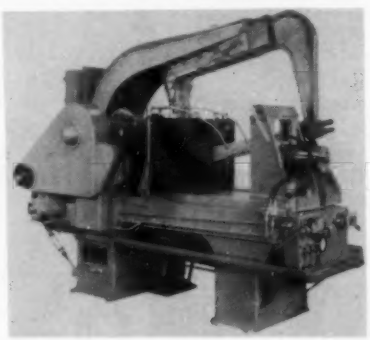


gears and splines and to ease off near the end of spur teeth. It can be preset for a completely automatic cycle of roughing, semifinishing and finish-grinding gears to 10 inches OD or operated in semi-automatic or manual cycle. Grinding wheels from 6 down to 3 inches in diameter are used. Because of the oscillating drive used when crown grinding, the crown radius is not affected by the diameter of the grinding wheel. A crown radius with a diameter as large as 12 inches can be ground on gears up to 10 inches in diameter. The grinder has a built-in coolant system with a 30-gal capacity. The wheel is mounted on motorized spindle rated at 2 hp at 3600 rpm. The automatic, hydraulically operated grinding wheel feed is adjustable for total feed in any predetermined number of steps. The wheel head is automatically reset at the time of indexing. Form templates are used with the hydraulically actuated diamond trimmer to trim wheels for grinding gears with diametral pitches from 64 to 4.

Gear Grinding Div., Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. **Circle 417**

Bandsaw Cuts Exotic Metals

Material up to 24 x 24 inches in size or with a 25-inch diameter can be cut on the Model 2424 hydraulic saw. A 36 x 4½ x 0.125-inch x 2T saw blade is used to obtain maximum capacity. A 10-hp, 4-speed motor and a built-in three-speed gear box provide 11 variables in speed from 12 to 145 spm. The stroke length is 6 inches. One feature of the machine is the adjustable



pressure type hydraulic feed with a range of 0 to 350 lb per sq in. A total downward pressure of approximately 4200 psi can be applied with the double main cylinders. A hydraulic chuck cylinder, adjustable vertically, holds the workpiece. The model is suitable for cutting high-density alloys, and the exotic metals such as titanium, beryllium or zirconium.

Racine Hydraulics & Machinery, Inc., Racine, Wis. **Circle 418**

Mounting Pads Reduce Vibration, Stop Creep

Reduced vibration and horizontal creep result from the use of Perf-O-Grip Vibra-Mount machine undermounting pads. Made of resilient wool felt with a series of perforations at spaced intervals, they are available in both general purpose and heavy-duty densities. One

For { 8-STATION PRODUCTION MACHINING
1½" BAR AND COLLET WORK
CHUCKING
SINGLE POINT THREADING

Costs { $7,167.00 FOB Factory Complete with all standard equipment

This is an all new 1½" bar capacity ram type turret lathe with power feeds to all 8 working stations . . . that in addition to bar and collet work also has the versatility to do chucking, and when needed, single point threading. Powered by a 5 h.p., two-speed, geared motor, the new Sheldon 3 R turret lathe provides 16 spindle speeds, 60 different feeds to the carriage and cross-slide, and 180 different feeds to the ram turret.
The turret itself is ruggedly built and accurately machined to provide close tolerance indexing. And for complete ease of operation, it is put under power by simply pressing a push button on the control panel.

This new 3 R Sheldon is completely equipped with two-speed motor and electrical controls, coolant system and splash guards, LO spindle nose, large satin chrome dials and hardened bed ways. It also provides an additional cost saving feature—each turret face is drilled and tapped for your standard flange type tooling as well as being bored for your standard 1½" shank type tooling.
For versatile, accurate machining in either long or short runs, the new Sheldon 3 R provides the answer to low investment cost with high profit operation.

New SHELDON
3R-TURRET LATHE

Write for bulletin with complete specifications and tooling data

SHELDON MACHINE CO., INC.
4229 N. Knox Ave. • Chicago 41, ILL.
Builders of 10", 11", 13", 15" Sheldon lathes, Sheldon Milling Machines, Sheldon Shapers and Sebastian Geared Head Lathes
See us at Booth #1250 ASTME Show, New York Coliseum.
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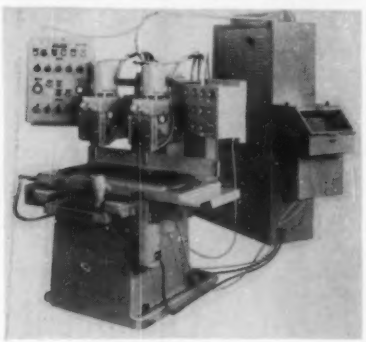
style is designed for loads from 10 to 50 psi and a second, for greater loads. They may be used with many types of industrial equipment such as grinders, boring machines, cylinder presses, power cutters, shears, punch presses, shapers, vertical presses and pumps.

American Felt Co., 2 Glenville Rd., Glenville, Conn. **Circle 419**

Tape Controlled Machine Drills Circuit Boards

This tape controlled drilling machine is designed to produce the complicated hole patterns in electronic printed circuit boards. It has a numerical positioning control with a tape reader which can be programmed by a Flexowriter or directly from the drilling machine using art work or a sample board. Up to four self-contained hydraulic feed drilling units can be used, adjustably mounted on the crossrail, to drill at speeds in the range of 50 hits per minute



per spindle. The compound motion table is traversed hydraulically with high-speed positioning by self-contained, closed loop, hydraulic circuits and reversible controlled motor driven pumps. Positioning accuracy is ±0.001 inch, nonaccumulative, with repeatability of ±0.0005 inch.

Leland-Gifford Co., Worcester 1, Mass. **Circle 420**

Vinyl Coating Protects Metals

Called Strip-Gard, this strippable vinyl coating eliminates marring and scratching of polished, embossed or coated metals during fabrication, storage and shipping. Recommended procedure is to apply the material as soon as possible after metal surfaces have been painted, polished or finished. Although not intended for permanent protection against weathering, it will not discolor or become brittle even when exposed outdoors for periods to six months. It can be applied by brushing or by conventional coating methods.

B. F. Goodrich Chemical Co., Cleveland 15, Ohio. **Circle 421**

Vertical Speed Reducer Has No Oil Seepage

This vertical, fan-cooled worm gear speed reducer is available in nine sizes with center distances ranging from 3 to 12 inches. Ratios extend from 4⅛:1 to 95:1 and ratings are from fractional to 175 hp. They have one-piece finned housings for maximum strength and heat dissipation. Gear shaft bearings are grease lubricated with two fittings for each bearing. One fitting is used as an indicator, showing that the bearing is fully packed if grease flows from it.

PRECISION Digest 1

PRECISION WELDER AND FLEXOPRESS CORPORATION • 3528 Ibsen Ave., Cincinnati 9, Ohio

2 Million Parts Per Die Grind

ESSEX JUNCTION, VT.—Every so often a Flexopress fails to live up to expectations.

Instead of increasing die life normally, it increases it to 2 million parts between grinds.

Instead of cutting cost per part a reasonable amount, it cuts it by 50 per cent.

Instead of assuming its typical share of downtime, it logs only two days off for maintenance in four years.

This machine does not wear a halo. It is a typical straight side, 50-ton Flexopress doing what it is supposed to do—blanking and forming critical steel parts for relays in the International Business Machines Corporation plant at Essex Junction, Vt.

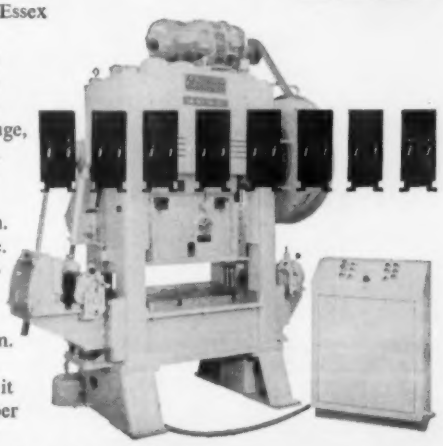
As the picture shows, the part is a relay armature insert with sharp corners and a couple of raised chevrons. Material: C-1010 steel. 22-gauge, cold rolled in coils. Tolerances: flat within .002"; corner burrs not over .002"; free from twist. Quantity: 200,000 per order, 2 orders per run. Production rate: 325 parts per minute.

Such speed of production ordinarily leads to severe scrap buildup, short die life, high costs, and sets the press to dancing 'round the room. But this is no ordinary press.

The solid carbide dies used with it turn out more than 2 million parts per sharpening (compared to 50,000 parts per sharpening for steel dies). Moreover, die sharpening time is now 1/40 of former time.

The biggest difference between the Precision Flexopress and any other press is its preloaded ball-bearing slides. They contain the ram without clearance, and therefore without slop. Preload on the slides exceeds the angular thrust load imposed by the action of the connecting rod and crank, so that the ram can move only in the plane of the slides—up and down but never sideways.

PRECISION



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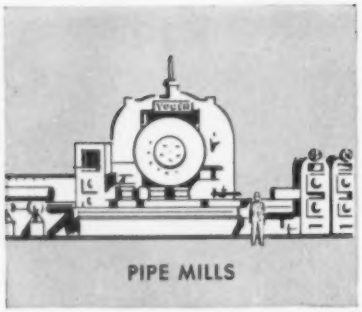


PIPE MILLS

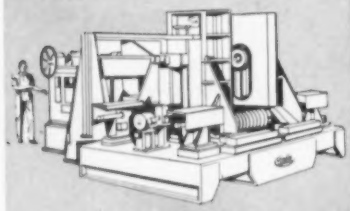
YODER PIPE AND TUBE MILLS

Today's expanding markets and tightening economy demand closer production cost control. YODER'S complete line of ferrous or non-ferrous Pipe and Tube mills can help you meet production schedules economically... help you realize significant savings in the manufacture of tube and pipe.

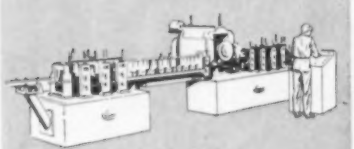
YODER Pipe and Tube mills offer flexible production to meet fluctuating demand. They adapt easily to the most rigorous schedules. Everyday manufacture of constant high quality pipe and tube in diameter of 5/16" to 24". Speeds up to 350 fpm plus can be obtained with YODER mills.

YODER also makes a complete line of Slitting equipment and Cold Roll-Forming machinery. Send for your copy of the fully-descriptive book covering Tube Mill operation.

THE YODER COMPANY
5525 Walworth Ave. • Cleveland 2, Ohio



HEAVY DUTY UNCOILERS



TUBE MILLS

ENGINEERING YODER MANUFACTURING
PIPE AND TUBE MILLS
(ferrous or non-ferrous)

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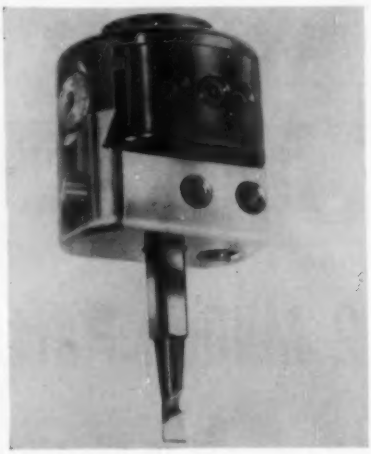
TOOLS of today

Oil seepage has been prevented by using a dry well around the output shaft and extending above the oil level.

Cleveland Worm & Gear Div., Eaton Mfg. Co., 3300 E. 80th St., Cleveland 4, Ohio. **Circle 422**

Boring Head Has Three Bar Holes

Three boring bar holes, dial screw graduations for direct reading and interchangeable shanks are features of this boring head. Its two vertical boring bar holes and cross hole for exact-



ing, rigid tool positioning and holding simplify and speed setups. Tools are locked into position by lockscrews. A completely enclosed dial screw provides adjustments which are read directly from the micrometer dial. The heads are satin finished.

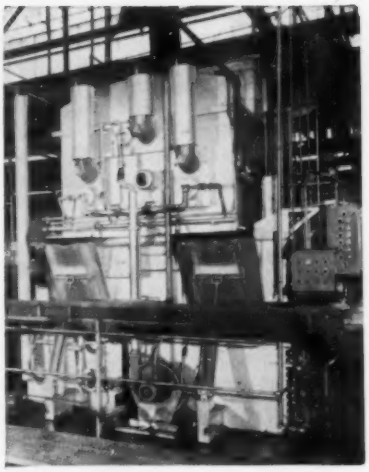
Lido Tools, P. O. Box 403, Costa Mesa, Calif. **Circle 423**

Miniature Scope Inspects Small Bores

Complete inspection of small bores is possible with a borescope having a shaft length of $4\frac{11}{16}$ inches and a shaft diameter of 0.145 inch. This permits using the inspection device in situations where no other method of inspection is possible. Right-angle vision is provided through a lens system which produces a magnified image that is clear, corrected and sharply defined. Power is supplied from a battery handle or transformer.

Welch Allyn, Inc., 199 Jordan Rd., Skaneateles Falls, N. Y. **Circle 424**

USE READER SERVICE CARD ON PAGE 135 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION



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- ✓ HARDENING
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HOLCROFT & COMPANY

6545 Epworth Blvd., Detroit 10, Mich.
Phone TY 4-5700

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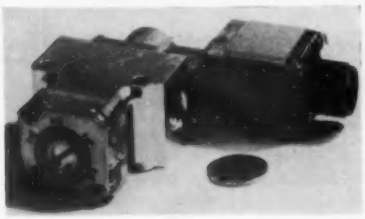
Switch Signals Pressure Differentials

When pressure, differential pressure or flow becomes too high or too low, the Deltadyne opens or closes the electrical circuit. This adjustable pressure and differential pressure switch provides indication over the range from 15 to 200 psi. Within the pressure range of a given switch, actuation pressure can be altered by turning a direct reading dial. This unit can withstand system pressures or overpressures up to 5000 psi. When used as a differential pressure switch, it exhibits actuation pressures which are completely independent of absolute working pressure. Other features include complete isolation of the electrical mechanism from the fluid and a magnetic detent which



prevents shaking when the switch is vibrated near its actuation point. Suitable for use in industrial and airborne systems, it can be used in all types of fluid lines including pneumatic systems and compressed gas lines, hydraulic systems, process streams and other types of fluid systems where an alarm device is required.

Pall Corp., 30 Sea Cliff Ave., Glen Cove, N. Y. **Circle 425**

Shaver Cutters Are Solid Carbide

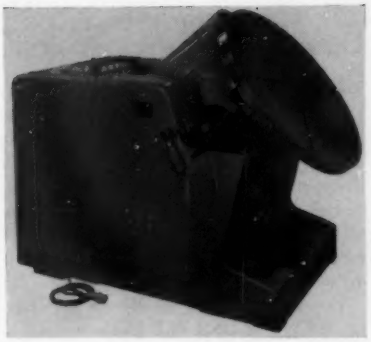
This line of weld and rivet shaver cutters can be used with many makes of weld and rivet shavers and edge mills. Available as standards in 1 and 1½-inch diameters and in ⅜, ½ and ¾-inch widths, each solid carbide cutter

is machine ground with a diamond wheel assisted by the low voltage electrical disintegration process. This minimizes grinding cracks and checks and provides a finish with no rolled edges. They can be resharpened many times.

Sonnet Tool & Mfg. Co., 576 N. Prairie, Hawthorne, Calif. **Circle 426**

Welding Positioner Tilts, Rotates Parts

Weldments and other assemblies can be mounted for positioning and rotation during welding or fabrication operations with the Model PM-1051 positioning machine. Assemblies weighing as much as 2000 lb can be mounted on the 32-inch-diam faceplate and secured to milled T-slots. Preselected angular positioning of the table from vertical to 15 deg beyond the horizontal level is automatically achieved by adjustment of a control protractor and a push-



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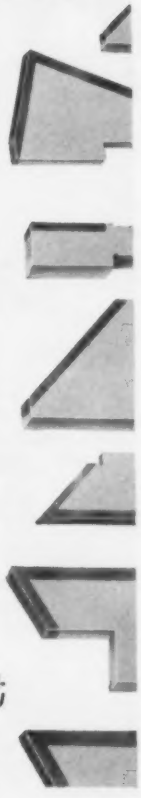
BETTER — our time proven process of bonding special analysis tool steel to tough machineable steel, then hardening the tool steel (65-66 Rockwell C) along entire length, enables us to give you hardened surfaces anywhere you want them.

FASTER — we make hundreds of these special shapes for every conceivable application—our new production methods are geared to meet fast delivery requirements.

LOWER-IN-PRICE — no one is as completely set-up — design, engineering, heat treating and production—to deliver these special ways to you at a price far below what it would cost you to make them yourself.

IMPORTANT — we carry in hardened stock 12 standard way shapes in 88 sizes, with delivery from stock to 5 weeks.



For FREE Bulletin-A, describing O-KNI-CO hardened ways, wear plates, etc., write Dept. 122-U

THE OHIO KNIFE CO.
CINCINNATI 23, OHIO
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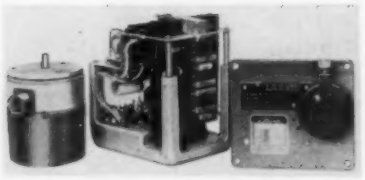
button energizing the drive motor. Right or left hand, vibration-free table rotation—also pushbutton operated—is accomplished by a worm and gear drive mounted in roller bearings and running in oil. A control knob permits selection of rotation speed from 0 to 4 rpm while a meter provides visual indication of the actual speed.

Boesch Mfg. Co., 45 River St., Danbury, Conn. **Circle 427**

Positioning Control Has 1:30,000 Resolution

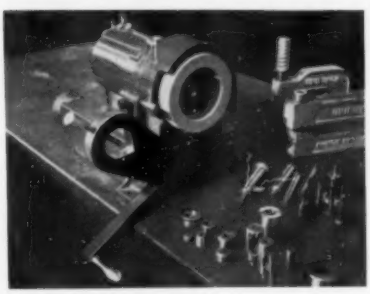
Three basic units—a position sensor, a solid state printed circuit amplifier and a digital readout position setter—comprise the HA-50 positioning control system. It has resolutions of one part in 30,000. The amplifier can drive a rotary or linear actuator. It can instead provide control for other electric or hydraulic drives. Its output may be solid state or from relays. A crossover circuit provides fast traverse and transfer to slower speed as preset position is approached. In a typical machine tool application, setting to 0.001 inch is provided over a 30-inch travel. Similar systems, with higher or lower accuracies, are used for valve positioning, variable speed drive control, process or programming control. Shaftrol actuators are available in various sizes, speeds, torques, enclosures and electrical characteristics. They can be face-mounted or shaft-mounted, to slip on control shafts in place of handwheels, or be furnished with special adaptors.



Jordan Controls, Inc., 3235 W. Hampton Ave., Milwaukee, Wis. **Circle 428**

Portable Grinder Has Built-In Fixture

This portable, bench type grinder is equipped with a built-in fixture to provide a convenient, economical method for sharpening punches and dies. Held securely in a V-holder, the parts are swung across the grinding wheel at 90 deg where a knurled feed handle feeds them to the wheel. Increments of 0.500 are scribed on the handle hub for control of the feeding. A cup type grinding wheel in one-piece cast frame is used. The grinder has a ½-hp, 3450-rpm, 115/230-volt, 60-cycle motor.



Punch Products Corp., Buffalo 6, N.Y. **Circle 429**

Retaining Ring Gives High Thrust, Impact Capacity

Designed for assemblies subjected to extreme loading condition, this external type retaining ring has high thrust load and impact resistance and provides a shoulder sufficiently high to retain parts having large corner radii or chamfers. Known as the series 5160, it is especially suitable for retaining bearings. It can be used without spacer washers to

ILLUSTRATED:
Speedgrip No. 3 Standard Straight Shank Mandrel, with hardened steel collet bushing.

SPEEDGRIP
EXPANDING MANDRELS

. . . are made from high grade alloy steel, heat treated; ground to precision gauges. Threads are ground after heat treating—assuring true perfection with the axis of the mandrel. Precision processing, combined with rigid inspection standards, give *Speedgrip* users maximum accuracy in their work parts. Many other advantages:

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Write for complete information. Ask for bulletin 26.

SPEEDGRIP CHUCK Division of ERNEST, HOLDEMAN & COLLET, INC., Elkhart, Indiana
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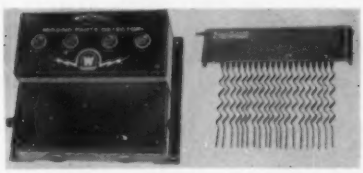
secure ball bearings, tapered roller bearings and cylindrical roller bearings. Because of its high load capacity, it can be used to replace heavy-duty nuts, machined shoulders and other bulkier fastening devices used to secure components on shafts, axles and similar structural members. The ring is available in 11 sizes designed for shafts ranging in diameter from 0.473 to 2.0 inch.

Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y. **Circle 430**

Device Detects Missing Parts

Designed for the protection of dies and machinery, the Model PD-510D missing parts detector stops the equipment instantaneously if it detects non-ejection, misfeeding, buckling, end-of-material and overloading. Detection is by means of a high impedence feeler assembly. The pulse probe receives an impulse from every part as it ejects. If the part impulse does not overlap the timing impulse from the device signalling the ejection sequence, the circuit is triggered. Conditions such as

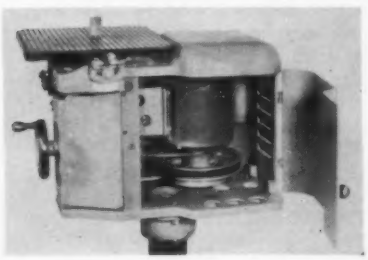


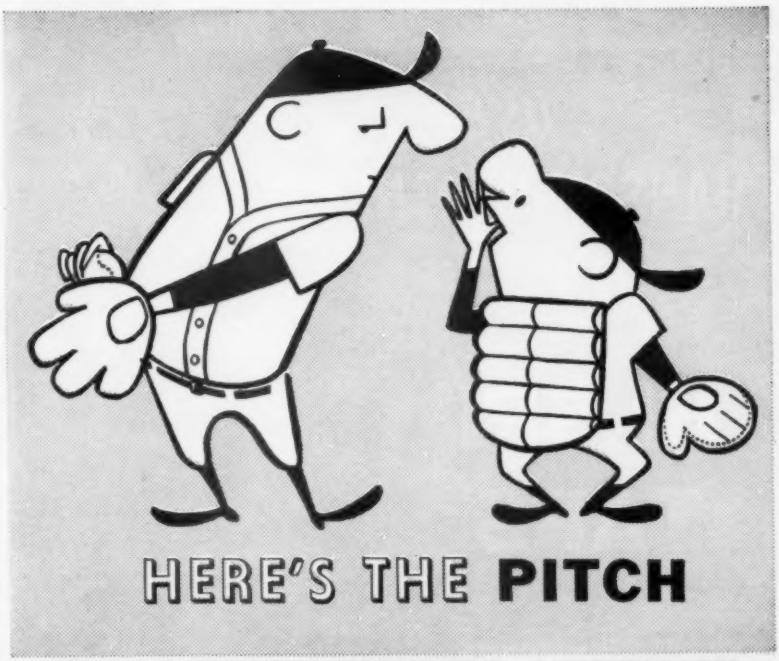
flooding of dies by water-based lubricants, oils, grease, etc., will not short out the probes.

Wintriss Controls, Div. of Industrionics Controls, Inc., 20-24 Vandam St., New York 13, N. Y. **Circle 431**

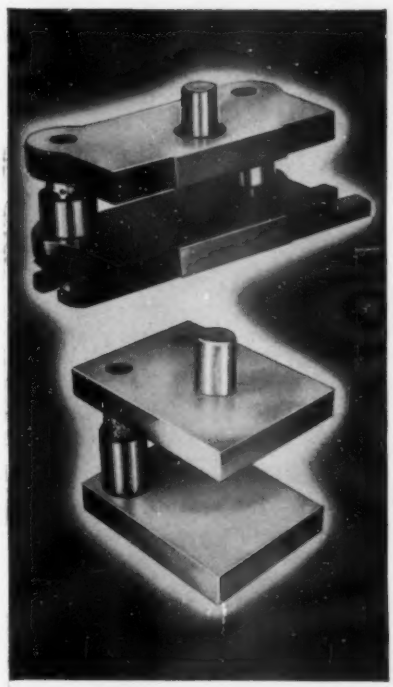
Profile Grinder Gives 35,000 rpm

Grinding of die clearances, cams and contours and many kinds of finishing work can be done with this line of profile grinders. A hinged access door facilitates interior maintenance and the 12 x 13½-inch serrated table has an improved U-bracket support and four-way tilt. The center line of the table coincides with the center line of the





ONLY **LEMPCO DIE SETS OFFER YOU "MINIMUM MAINTENANCE" OPERATION**



Operating on Ball Bearing Bushings, with Aluminum Alloy Retainers, Lempco Die Sets deliver millions of strokes, retaining phenomenal precision of alignment, requiring only an occasional dab of grease for lubrication.

NO OTHER DIE SETS HAVE LEMPCO FEATURES!

Better look at those Lempco "M" and "L" style die sets, too; they're *all-steel* yet sell for the price of cast iron.

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and...
REDUCE YOUR COST
BY INCREASING
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20% or more.

Hanson-Whitney HI-SPI TAPS are **designed to reduce tapping cost** by permitting **faster tapping** in ductile materials. This "Faster Tapping" capability of HI-SPI TAPS is being proven over and over again by Tap Users.

HI-SPI TAPS offer many advantages. Some of these are:

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- **Greater torque strength.**
- **Highest permissible tapping speed.**
- **Highest quality thread.**
- **Most uniform tapped hole accuracy.**

HI-SPI TAPS *are AVAILABLE when you need them . . . they are stocked by your Hanson-Whitney Distributor*

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TAPS • GAGES • COMPARATORS • HOBS • CUTTERS

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spindle so that grinding wheels operate in the center of the table hole at all working angles. The wheel dresser is attached to the underside of the table. It has no loose parts to require preassembly. Spindle speeds are available in 20,000, 30,000 and 35,000 rpm ranges for single speed machines and in 20,000 to 30,000 and 20,000 to 35,000 rpm ranges for two-speed machines. Although the grinders are bench type, they can be mounted on a pedestal or four-legged floor stand. The 3450-rpm motors are rated at ½ hp.

Rice Pump & Machine Co., Belgium, Wis. **Circle 432**

Milling Cutters Rough, Finish

Designed for either roughing or finishing of cast iron where high speeds and feeds are required, the series 7100 Rigidcut face mill has large brazed-on carbide blades. Because the corner angle on the fine-pitch blades used in these cutters is ⅜ inch by 45 deg, cut-

ters should be used on cuts to 5/16 inch. For finishing, the ⅝-inch face of the blade can be ground, either to be free cutting or to provide a surface with an extra fine finish. They are available with diameters from 6 to 20 inches in 1-inch increments.

Wesson Co., 1220 Woodward Heights Blvd., Ferndale 20, Mich. **Circle 433**

Lapping Plate Finishes Plastics

Fine finishes on Teflon, nylon and other nonferrous materials can be produced when this noncontaminating hand lapping plate is used. It is 12 x 18 inches in diameter and 3 inches thick. The lapping surfaces are grooved with ⅛-inch deep serrations spaced ½ inch apart. Advantages of the plate include not only finer finishes but also better appearance and the elimination of the danger of a contaminator causing malfunctioning of the lapped part.

DoALL Co., Des Plaines, Ill. **Circle 434**

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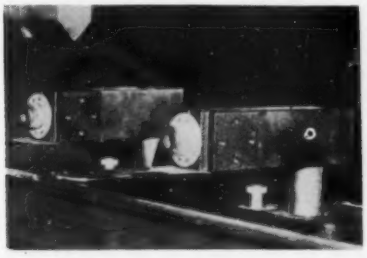
Gage Has Built-In Rectification

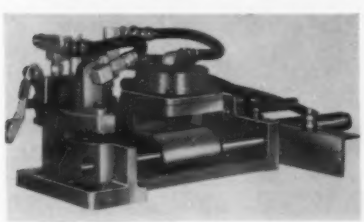
Each Quickage—a device for gage-setting—contains its own built-in rectification so that it operates directly from any on-off switch. Using a square, scale or sample workpiece, the gage is positioned on a steel plate clamped behind the die. The on-off switch is placed at any point convenient to the operator. When the switch is on, the unit holds its position magnetically, requiring no mechanical clamping. Micrometer vernier adjustment to 0.001 inch can then be made by rotating the dial with a Q-wrench. Shock absorbers prevent shifting under impact so that the lightest sheet aluminum or the heaviest sheet steel can be gaged. Either flexible spring fingers for gaging on the die or sturdy fingers for gaging behind the die are available. The gage can be used on press brakes, presses and shears and for such work as back or front gaging, step gaging, multiple bending and special positioning.



American Actuator Corp., P. O. Box 384, Stamford, Conn. **Circle 435**

Press Feeder Is Air-Actuated

Light coiled material can be fed to punch presses at speeds to 250 spm and with an accuracy to 0.002 inch with the Junior air feed. It can feed materials up to 4 inches wide and thicknesses to 0.06 inches. Stroke lengths are adjustable to 4 inches. Adjustment for stock width is easily made by repositioning the guide roller at the stock entrance end of the air feed. The gripper head, which carries the stock forward on its feed stroke, travels between hardened metal-to-metal stops. The stock is cushioned for the last ½-inch of travel by a built-in air check. The



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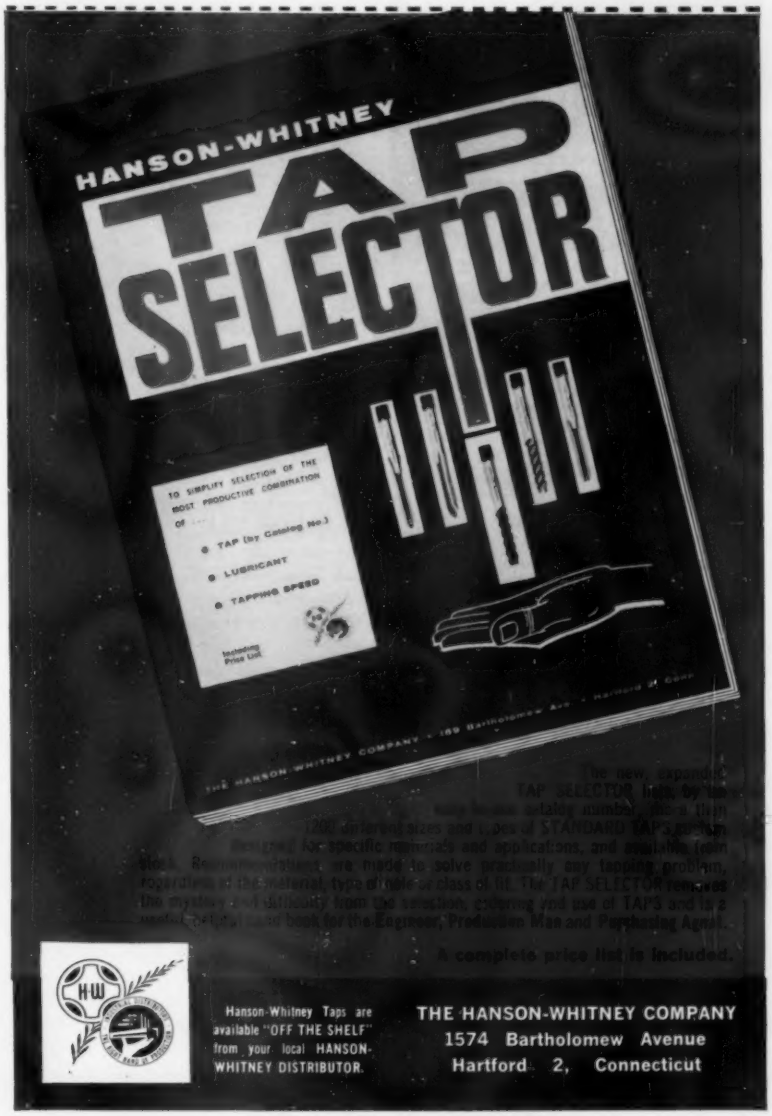

Hanson-Whitney Taps are available "OFF THE SHELF" from your local HANSON-WHITNEY DISTRIBUTOR.

THE HANSON-WHITNEY COMPANY
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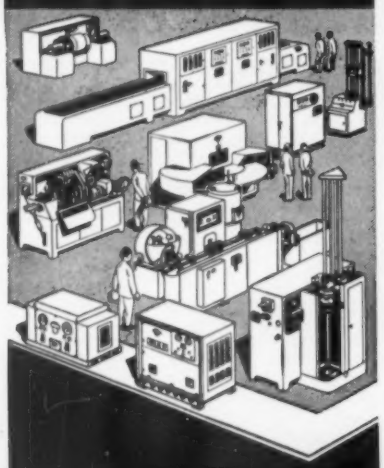

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Subsidiary of HATHAWAY INSTRUMENTS, INC.

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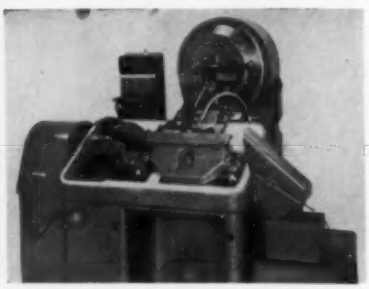
air feed is timed with the press by a roller cam type air valve which is mounted on the side of the air feed. As the ram of the press goes up, an actuating plate mounted to the ram rides off the roller cam valve. This cycles the feed and causes it to index the stock forward into the punch press. The feed can be mounted to a press to feed material from any direction.

Ses-Matic Press Equipment, Div. of Special Engineering Service, Inc., Dearborn, Mich. **Circle 436**

Thread Roller for High Production

Capable of producing from 135 to 400 pieces per minute, Model 400-R thread rolling machine has a large capacity hopper and infinitely adjustable speed from 4.5 to 11.5 rpm. Thread lengths



can be rolled from ⅛ inch to 1½ inches. Screw capacity is from No. 2 through No. 10 on the automatic model and from No. 0 to No. 10 on the manual model. Both models have adjustable starter fingers with variable height and stroke. An eccentric cam adjustment controls the relative position of the moving die for easy die matching. Die spacing can be adjusted through longer spacing between the adjusting screws. They have straight line feed rails which minimize wear and provide trouble-free feedings. A mechanical type feed rail vibrator assures uninterrupted feeding of blanks. Other features include a vinyl-lined hopper and a separate coolant system.

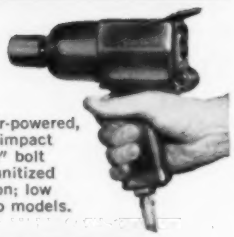
Hartford Special Machinery Co., Simsbury, Conn. **Circle 437**

Comparator Screens Parts by Weight

This production line electronic system—the Atronic Weight Comparator—automates the selection and screening of parts and materials. When used in a processing or production operation, it handles a continuously moving stream of parts or materials, weighs each item, automatically compares this weight to

2 NEW HIGH PERFORMANCE TOOLS JOIN AIRETOOL LINE...

1



Rugged, air-powered, reversible impact wrench; ½" bolt capacity; unitized construction; low torque; two models.

2

400-T sheet metal tapper; runs at 400 rpm; rugged construction; reversible; muffled air motor; lightweight, easy to handle.

Where production demands are highest, you'll find Airetool fastening and production tools meeting or exceeding requirements, and the new 625 and 626 impact wrenches and 400-T tapper are no exceptions. Airetool's complete line of quality, job-proven, pneumatic production tools includes nutsetters, screwdrivers, drills and grinders. When you want production . . . you need Airetool.

For complete information, write

AIRETOOL MANUFACTURING COMPANY
SPRINGFIELD, OHIO

REPRESENTATIVES in principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii.
CANADIAN PLANT: Brantford, Ontario.
EUROPEAN PLANT: Vlaardingen, The Netherlands.

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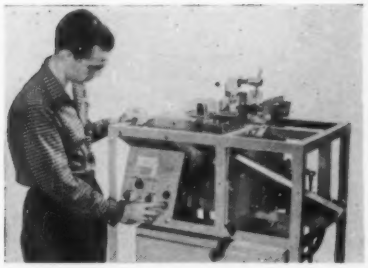

within plus or minus one gram of a predetermined amount and either accepts or rejects the item. The system handles parts weighing up to 5 lb.

Atronic Products, Inc., West Conshohocken, Pa. **Circle 438**

Air Filter Reservoir Resists Damage

Compressed air filters and lubricators can use this reservoir, which has a metal bowl and a visible indicator of the level of fluid inside it. The level of the contents in these bowls is visible a full 230 deg so that it can be seen from virtually all directions. When in-

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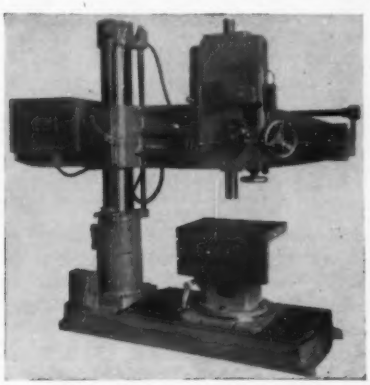
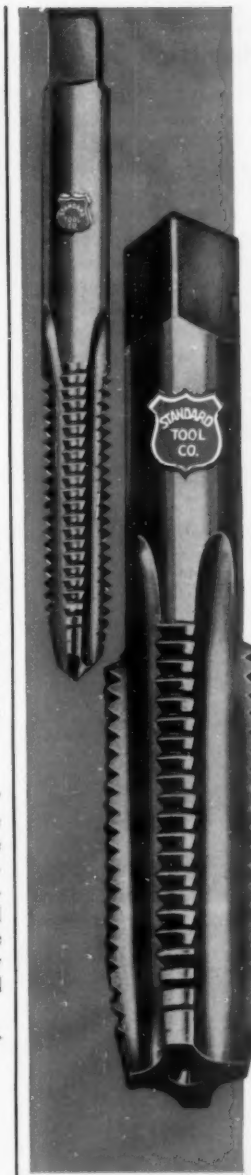
stalled on an air line, the sight gage can be rotated to give even wider angle visibility. High temperatures, high pressures, steam cleaning, solvents, synthetic compressor oils and impacts will not damage the bowl. The pyrex tube is protected from accidental impact by a thin metal strip running its full length.

Wilkerson Corp., Englewood, Colo. **Circle 439**

Radial Drill Has Centralized Controls

Providing 12 spindle speeds, 6 spindle feeds and 12-inch spindle travel, the redesigned Mor-Speed radial drill has completely centralized controls; a totally enclosed elevating mechanism with





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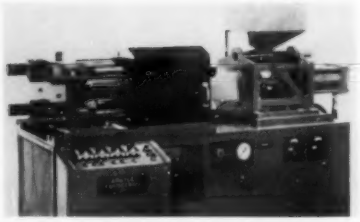
electric column clamp; and roller bearing mounted head. The external electrical conduit has been eliminated, and column clamp control buttons are flush mounted. Total vision lighting assures complete illumination of the workpiece and elimination of operator blind spots. A positive displacement lubrication system provides lubricating efficiency.

Morris Machine Tool Co., Cincinnati 2, Ohio. **Circle 440**

Inspection Molding Machine Has High Speed

Among the features of this 3¾-oz plasticizing machine are a base design which provides accessibility to the entire pumping unit; a hinged hopper shut-off; a feed control; built-in water cooling lines; a straight through opening for conveyor system; fuse breaks on all heater bands; cam-lock design of stationary platen; and plug-in type cycle timers for easy replacement. Another feature is the water-cooled plunger which permits maintaining proper clearance between plunger and feeding bushing. This lessens the chance of galling and sticking of the plunger. Its 8-inch long stroke and 14½ x 21-inch platen area permit the plasticizing of large deep molds as well as shallow molds. The high speed—720 strokes per hour—is accomplished without mold slam or shock, protecting the mold from excessive wear caused by impact. The Argyle 4-125 plasticizes as much as 75 lb of any molding material per hr.



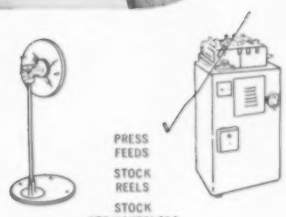
Bell Machinery Co., Inc., Los Angeles 58, Calif. **Circle 441**

Why Dickerman punch press feed users–

Select the TOUGH feeds with the TENDER touch!

Dependably feeds strip up to 3/16" thick and 2 lbs. per linear foot.

Efficiently feeds stock you can practically see through.



The Dickerman 2½" Hitch Feed®, one of the bantams of the line, feeds stock as fine as 003", in thickness, in widths up to 2½".

The Dickerman 12" Rol-Di-Feed, largest in the line, feeds stock up to 3/16" thick and in any width up to 2 lbs. per linear foot.

There are 15 "standard" feeds in the complete, versatile Dickerman line.

They all feed as fast as it is wise to run the tooling . . . and a hundred-million pieces, without major maintenance is routine.

You can gently feed a small fraction of an inch with a "Hitch Feed" or you can accurately position big, rugged strip stock up to 12" per press stroke with the Rol-Di-Feed.

Versatile, Dependable Production Savings are the reasons for specifying Dickerman Feeds. Prove it to yourself.

Dickerman

H. E. DICKERMAN MFG. CO.
321-103 Albany Street • Springfield, Mass. Send for literature and prices

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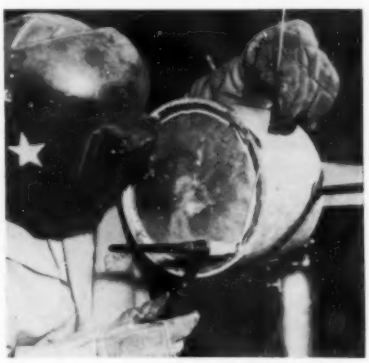
Welder Holder is Air-Cooled

Air-cooled with 160 amp a-c or d-c continuous capacity, the H16-A Heliweld holder provides welding of thin gage aluminum, alloy and stainless steels, brass, copper, magnesium, molybdenum, nickel, silver and other metals. Its 2⅞-inch head clearance permits its use in confined spaces. Its air-cooled construction eliminates the need for a water system. Nozzle orifices—made of alumina—are available in 1¼ and 1⅝-inch lengths. It can handle tungsten electrodes from 0.020 through 5/32 inches in diameter and from 2 to 7 inches in length. Argon, helium or mixtures of argon and helium shielding gases can be used.



Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y. **Circle 442**

USE READER SERVICE CARD ON PAGE 135 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Automatic Turret Drive Has 32 Spindles

With a single complement of tools in its 32-spindle turret, this numerically controlled turret drill can perform 90 percent of the drilling-tapping jobs in the average shop. At the command of a punched tape, the tools are selected and positioned by a system which provides positioning accuracy of ±0.001 inch. The spindles have eight feed rates from 0.001/rev to 0.030/rev and 16 speeds ranging to 2500 rpm. Feed is also provided on both table and saddle for point-to-point milling. Twenty-three inches of daylight between the spindle nose and table top make this machine

capable of handling bulky work. The 18 x 34-inch table has 18 x 24 inches of travel. It moves in rapid traverse at 200 ipm, so that, on the average, only three seconds are required to locate the workpiece hole-to-hole. Zero offset permits positioning the workpiece at any location on the table. The machine is powered by a 3-hp motor.

Fosdick Machine Tool Co., Cincinnati, Ohio. **Circle 443**

Involute Checkers Remove Operator Variables

This involute checker provides optical setting for the Sine-Line lead checker. Angles to 0.001 deg can be set without the use of gage blocks with repetitive checking accuracy of 0.0001 inch. This device is used to check involute profiles on spur or helical gears and to check tooth spacing. The gear to be checked is mounted between centers and the indicator sensing probe is brought into contact with the involute contour. The indicator is set with the optical system so that its tip travels in a path tangent to the base circle. Movement of the indicator sensing probe, along the line of action, and rotation of the gear are synchronized so that for each degree of gear rotation, the indicator moves a distance equal to $\frac{1}{360}$ of the circumference of the base circle of the gear. These checks are based on the use of a

(Continued on page 137)

Nobody, but nobody, tends your die set needs with such dispatch as Danly. Whether you want a new Precision Pilot Guide Post for extra ease in die set assembly . . . or a fast order placed for a special die set, you can depend on your nearby Danly man for quick, effective action. Like all 23 Danly branches and distributor assembly plants, he stocks a wide selection of die sets and diemakers' supplies for immediate delivery. Next time you need die set service, call your Danly man. He's as close as your phone—and at your service 'round the clock.

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DANLY MACHINE SPECIALTIES, INC., 2100 South Laramie Ave., Chicago 50, Illinois

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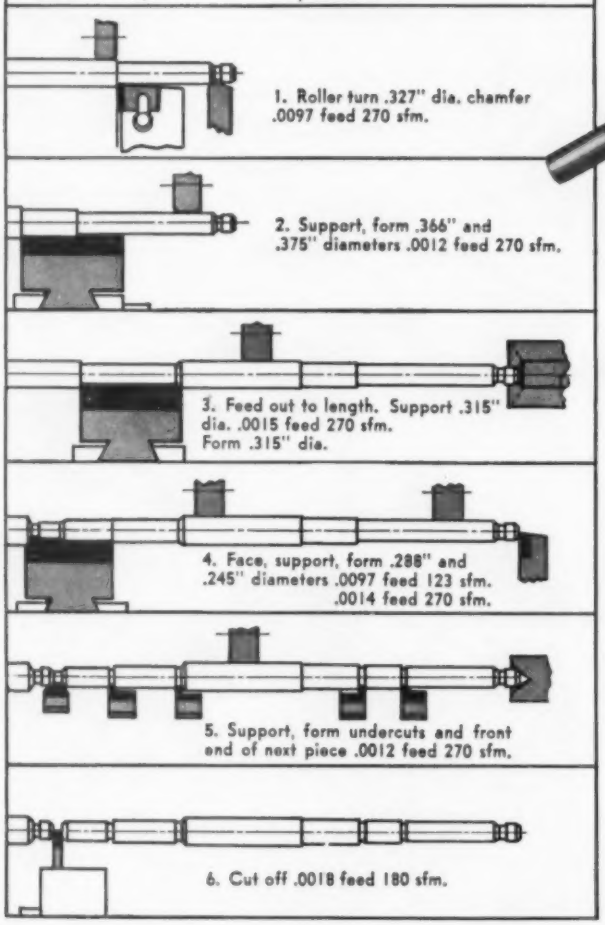
GREENLEE AIR-FEED AUTOMATICS BENEFIT "ELECTROLUX" FOUR WAYS . . .

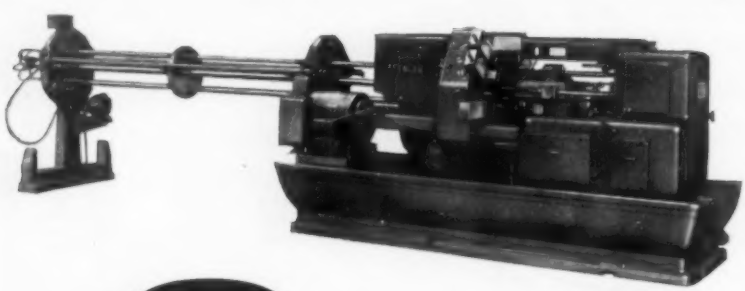
MACHINE . . . 1"-6 Automatic Bar Machine Air-Feed — Feedout on index and in 3rd position during machine cycle. TOOLING . . . Carbide Tipped MATERIAL . . . 1137 STOCK SIZE . . . 13/32" rd.	TOOL SLIDE STROKE . . 1-9/16" at .0097" feed. SPINDLE SPEED . . . 2540 rpm 270 sfm. MACHINE TIME . . . 5.8 seconds. ESTIMATED GROSS PRODUCTION . . . 620 per hour


1. Roller turn .327" dia. chamfer .0097 feed 270 sfm.
2. Support, form .366" and .375" diameters .0012 feed 270 sfm.
3. Feed out to length. Support .315" dia. .0015 feed 270 sfm. Form .315" dia.
4. Face, support, form .288" and .245" diameters .0097 feed 123 sfm. .0014 feed 270 sfm.
5. Support, form undercuts and front end of next piece .0012 feed 270 sfm.
6. Cut off .0018 feed 180 sfm.

1. Eliminate stock pushers . . .
2. Eliminate scoring of stock . . .
3. Reduce downtime during set-up . . .
4. Provide extra length feed-out . . .

The part is a 6-7/8" long armature shaft used in the "Electrolux" vacuum cleaner. It demonstrates how effectively Greenlee Air-Feed Automatics and carbide tooling can team-up to increase production and reduce costs. The shaft is machined from 13/32" S.A.E. 1137 steel at a gross production rate of 620 pieces per hour. Recommended cutting speed for high speed tooling is 120 sfm. The rate was boosted to 270 sfm with carbide-tipped tooling. Sequence of operations is shown at the left.

Note how the stock is partially fed out on the index and to its full length in the third position. This provides for the most effective tooling arrangement. Greenlee Air-Feed Automatics permit greater job versatility and assure added profits. See your Greenlee representative or send us a print of your high-cost problem-part.



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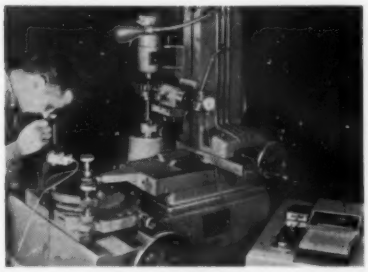
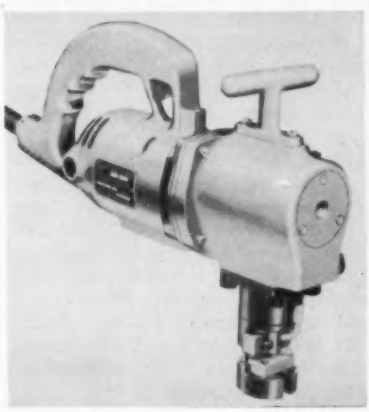


sine bar to obtain the proper ratio between the single master disk and the base diameter of the gear being checked. Gears from 1 to 30 diametral pitch can be checked.

Michigan Tool Co., 7171 E. McNichols, Detroit, Mich. **Circle 444**

Nibbler Uses Punch and Die Principle

Capable of developing the pressure of a two-ton press, the No. 691 portable sheet metal nibbler has many uses in sheet metal and tin shops, steel mills, rolling mills, template shops and truck and trailer body shops. It operates on the punch-and-die principle, punching out small rectangular pieces as it is fed along the cutting line. The grip handle, positioned for balance and one-hand operation, enables the operator to reach out over wide material. An instant-release trigger switch and a front T-handle improve control and accuracy for continuous work. It has an automatic oiler for lengthening punch and die life. Mild



steel to 8-gage, stainless steel and Monel of lighter gages and copper to $\frac{3}{16}$ inch can be cut at 1000 spm, no-load, or 600 spm at rated load.

Black & Decker Mfg. Co., Towson 4, Md. **Circle 445**

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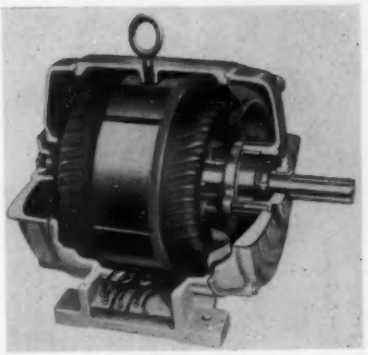
Insulation System Protects Open Motors



Because it is protected against moisture, chemicals, oils and abrasive contaminants, this encapsulated random wound a-c induction motor has longer life in adverse environmental atmospheres. A heat-resistant, plastic resin that completely seals end coils and fills spaces between wires in the stator slots with a moisture-proof, chemical-resistant, protective sheath is used. The material has high dielectric strength and good thermal endurance, permitting

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- **Adapters to fit any punch press**

Di-Acro Punch-Paks save you money, cut production delays. No time lost looking for the right size or waiting for special orders. Cost is approximately 10 per cent less than individual punch and die sets—with the rugged, steel store-or-carry chest free. All Di-Acro Punches and Dies are precision made of quality tool steel.

PUNCH-PAK NO. 1 contains 30 sizes of round punches and dies from 3/64" to ½" in increments of 1/64".

PUNCH-PAK NO. 2 contains round punches and dies from 1/16 to ½" in 1/16" increments, round sizes from ½" to 2" in ⅛" increments, squares in ½", ⅝", ¾" and 1" sizes, one die holder and two die adapters.

Die Adapter A-2 ¾" diameter—1¼" bore, Die Adapter B-2 ¾" diameter—2⅛" bore.

DIMENSION DATA

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All Di-Acro Dies to ¾" are 1¼" diameter, ⅝" high.
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All Di-Acro Dies from 1½" to 2" are 2¾" diameter, 15/32" high.

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which adapt Di-Acro Punches and Dies to any punch press are listed in literature on single station punch and die program. Ask for it . . . also for literature on new Adjustable Punch and Die program.

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TOOLS of today

operation over wide extremes and under sudden changes of temperature without cracking, crazing or breaking the bond between the plastic compound and stator laminations or windings. High resiliency of the material allows it to withstand the effects of airborne contaminants drawn into the motor by the ventilating air stream.

Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis. **Circle 446**

Toolholder Has Built-In Micrometer

Disposable carbide cutting edges which provide much longer wear resistance in cutting operations, yet cannot be brazed normally due to danger of cracking, can be handled by this cutting tool holding system. The system basically stems from a micrometer built into the cartridge which permits adjusting the cutting edges in seconds. Type S

has a button head screw which seats and holds the insert and shim assembly accurately in the smaller hole sizes down to $^{15}/_{16}$-inch-diam holes. Type C has a clamp-on arrangement used to release the shim, chipbreaker and insert for fast indexing. This style is particularly well-suited for large bore sizes for light, medium and heavy machining. Both styles are manufactured for either angular or straight mounting.

Microbore Div., DeVlieg Machine Co., Royal Oak, Mich. **Circle 447**

Belt Machine Polishes Tubes

In 8 sec, the Model TP2 tube polisher cleans and polishes the exterior end of a boiler tube over a 4-inch length. This compares to 90 sec normally required per tube when hand labor and emery cloth methods are used for polishing heat exchangers and condensers. The device can accommodate 1 to 2-inch OD boiler tubes. It is driven by an air motor which spins a pair of abrasive belt sanders and simultaneously rotates

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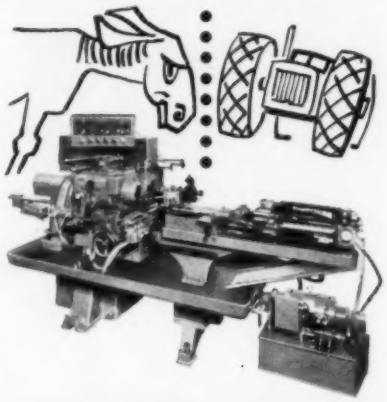
Transform your stubborn mule to a prime mover



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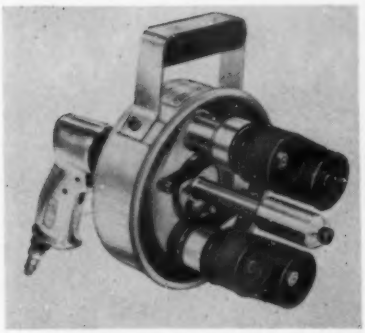
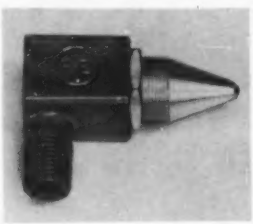


them in a 360-deg circle around the tube end. A cast aluminum guard protects the operator at all times from rotating parts.

Hi-Shear Corp., 2600 W. 247th St., Torrance, Calif. **Circle 448**

Optical System Detects Small Parts

This lens-holder and tunnel aperture was designed for use on either the light-source or the photocell of the Farmer miniature photoelectric scanner to increase the ability of the system to detect small objects and small movement. When used on the photocell, the unit provides a narrow field of vision that enables the scanner to detect small objects over distances up to 10 ft and to detect movement as low as 0.001 inch for slow-moving objects near the photocell. It also minimizes the effect of ambient light. When used on the light-source, the lens holder produces a small, sharply defined round spot of light—$\frac{1}{64}$ inch in diameter at $\frac{1}{4}$ inch



from the lens—which enables the scanner to detect objects 0.010 inch in diameter or to follow lines in a tracing operation.

Farmer Electric Products Co., Inc., 2300 Washington St., Newton Lower Falls, Mass. **Circle 449**

Electronic Drive Has Wide Speed Range

With a speed range from 2:1 to 100:1, this adjustable speed drive operates from a single-phase, a-c supply. A pair of grid-controlled thyratrons and diode tubes provide full wave rectified voltage to the drive motor armature. For precise speed regulation regardless of

premium power *
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- 30% wider rotor blades for longer life, greater power
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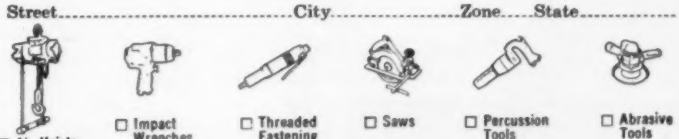

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FILTER
LUBRICATOR

This **compact package unit** removes dirt, grit scale and moisture—prevents rusting and scoring—balances air surges—serves as shut-off valve.

Saves many dollars and valuable time by preventing unnecessary maintenance—down-time—and replacement of costly air tools and equipment.

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Large orifice and piston maintains accurate pressure adjustment. Automatic bleed-off saves valuable set-up time. Balances pressure surges. Proper pressure assures peak performance.

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Automatic foglike oil mist protects and lengthens service life of air tools and equipment. Prevents costly repairs and replacement of air tools due to scoring and rusting. Assures long trouble-free service.

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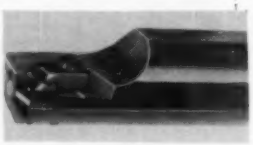
TOOLS of today

load, a drop compensating network is employed. The drive has short circuit protection, under-voltage and overload protection, a timed method of accelerating to preset speed, a regulated speed reference supply and tube circuits that are fail-safe on filament burn-out. The unit, class 8833 type BG, includes the controller, pushbutton station and drive motor and is available in ratings from ¾ to 4 hp.

Square D Co., 4041 N. Richards St., Milwaukee 12, Wis. **Circle 450**

Boring Bars Have Adjustable Chipbreakers

Carbide throwaway inserts and adjustable chipbreakers are features of two new boring bars. Style VBS uses a square carbide insert with a 15-deg lead angle for through boring while

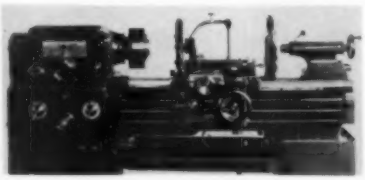


Style VBT uses a triangular insert with a 90-deg lead angle for machining to square shoulders. Both are available in sizes ranging from 1.375 to 2.750-inch minimum bore diameters.

Valenite Metals, Box 205, Royal Oak, Mich. **Circle 451**

Geared Headstock Lathe Has Wide Speed Range

Mounted in the headstock base of the Lansing T lathe is a 7½ and 10-hp motor which permits, through dial type controls, spindle speeds from 46 to 2000 rpm. The camlock spindle of this geared headstock is supported in bearings and has oversize bores of 2⅛ and 3 inches. A quick change sealed gearbox with its own lubricating pump and dial feed offers longitudinal and transverse feeds separate from threading feeds. The carriage has an automatic multistop mechanism for longitudinal and transverse settings. It also has a one-shot system to the ways.



S & S Machinery Co., 140 53rd St., Brooklyn 32, N. Y. **Circle 452**

NEW BROKEN TOOL DETECTOR

"Detect-A-Tool" is the new space saving solution to the problem of detecting tool breakage on automatic machine tools and transfer lines

Expensive probe stations are eliminated as well as their attendant maintenance cost and floor space requirements, as the "Detect-A-Tool" is mounted on the work station itself.

Since the tools are checked each time they are used, tool failure is detected immediately and scrap losses from tool failures are eliminated.

"Detect-A-Tool" equipment can be easily installed on both old and new equipment. There are no complex moving parts to wear or get out of order, and little or no maintenance is required. Coolants, oils, or chips will not affect operation in any way.

"Detect-A-Tool" units are presently available for tools having effective diameters from 3/32" to ¾".

This equipment features the same rugged construction and conservative electrical design that typifies all "MEK" products.

Complete "Detect-A-Tool" descriptive literature will be sent on request.

Manufacturers of
- *Electronic and Magnetic Controls*
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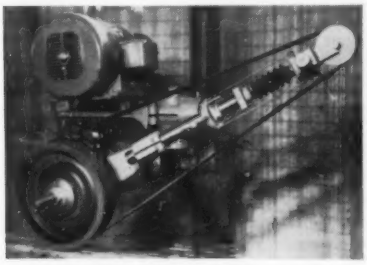
Adhesives Bond Metals, Plastics

Any of four curing agents mixed with Epon adhesive 901—a solvent free epoxy paste—results in adhesives that are thixotropic even during cure at high temperatures. With tensile strengths to 3800 psi, they bond stainless steel, aluminum, titanium and most other standard and Space Age metals and rubber, reinforced plastics, glass, ceramics and bondable nylon and teflon to each other or in almost any combination of materials. They are resistant to salt spray, water and most organic liquids. The four curing agents offer cure conditions from room temperature to 300 F and will meet most bonding requirements. All four agents are color-indicating in that they change the adhesive color from grey to red when paste and liquid have been mixed thoroughly.

Shell Chemical Co., P. O. Box 831, Pittsburgh, Calif. **Circle 453**

Abrasive Belt Attachment for Buffing Lathes

Additional abrasive belt polishing operations are made possible by this abrasive belt arm attachment for buffing lathes. Easily mounted on the spindle housing, the belts are spring loaded between a contact wheel and an



idler pulley. A spring loaded lever permits rapid belt changing. Tracking of the belt is achieved through an adjustable mechanical device. Various sizes will handle belts from 2 to 8 inches in width and 96 to 132 inches in length.

Acme Mfg. Co., 1400 E. Nine Mile Rd., Detroit 20, Mich. **Circle 454**

Riveter Has 10,000-lb Setting Force

This riveting machine which is powered by a pneumatic-hydraulic system, has a 12-inch throat depth and is designed to feed and set either of two length rivets up to 5/16 inch in diameter. Operating on 80 psi air pressure, its hydraulic booster and cylinder delivers a setting force of 10,000 lb. This setting force is applied only during the last downward 1/2-inch travel of the spindle. The first 3 1/2 inch of down stroke and the entire retract stroke use low-pressure oil. It has two sets of feeding parts, an air and spring pin anvil and a work support bracket. The

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selection of the rivet length required is done by a section of the workpiece contacting a mircoswitch mounted on the work support bracket. Air, controlled by a foot valve, raises the anvil pin above the standard projection to float the rivet past obstructions. Motion of the driver releases air permitting the pin to retract and the rivet is set with spring pin anvil action. With the pin in the retarded position, maximum clearance is provided for the workpiece. The foot valve at the left controls the anvil pin and the foot switch to the right trips the machine.

Tubular Rivet & Stud Co., Quincy 70, Mass. **Circle 455**

(Continued on next page)

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PROMISES YOU CAN BANK ON—Special event in the life of an Oberg Carbide Die is D-Day! When you commission Oberg to design, engineer and build your Die, this date is effective with approval of its final design details. Oberg engineers and craftsmen know and respect D-Day as thoroughly as they do the intricate parts of your Die. If requested, and material is supplied, your Oberg Carbide Die will be production-proved. You can plan to attend these tests for practical experience and the best operational practices. You'll find . . .

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BE SURE TO VISIT BOOTH 2146 at the ASTME 1961 Exposition in New York

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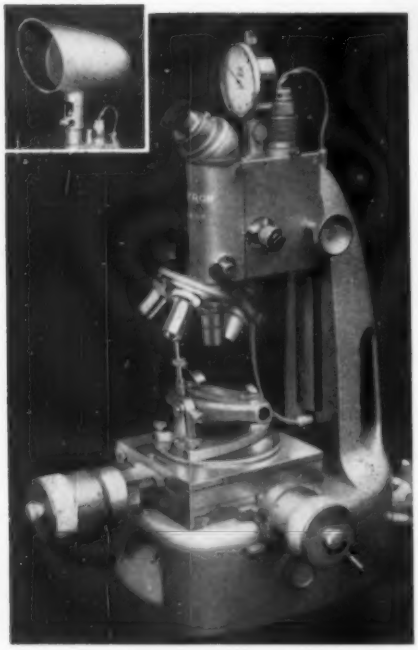
Blank Feeder Has Magnetic Pick-up

Fully automatic, high-speed stack-top feeding of flat metal blanks is provided by this machine which is equally applicable to low and high-production metalworking plants. Powered, magnetic rolls and magnetic belt transfer the blanks, lifted one-at-a-time from the top of the work stack, from the pick-up to the operating machine. The roller section can receive stacks of blanks as high as 18 inches. A hydraulic lift section maintains stack level at the pick-up and returns for a new stack from the roller section. The machine is available in models to accommodate flat blanks from 10 inches in diameter to 30 inches square or from 0.015 to 0.125-inch-thick ferrous metal. Operating at speeds to 100 parts per minute, this feeder is adaptable to any type vertical or inclined press, shear or brake.

Clark Industries, P.O. Box 314, Delaware, Ohio. **Circle 456**

MEASURE TO 0.0001" IN 3 DIMENSIONS WITH UNITRON'S TOOLMAKERS MEASURING AND METALLURGICAL MICROSCOPE



The UNITRON Model TM is more than just a measuring microscope. It is the only instrument which combines in one stand a completely equipped toolmakers microscope for precise measurements — LENGTH, WIDTH and DEPTH, and a metallurgical microscope for examining the structure of polished metal samples under high magnification.

NOTE THESE QUALITY OPTICAL & MECHANICAL FEATURES

- **Objectives:** achromatic, coated, 3X, M10X, M40X. **Eyepiece:** coated Ke10X with crosshair.
- **Magnifications:** 30X, 100X, 400X; up to 2000X with accessories.
- **Focusing:** Both dual control rack and pinion coarse and micrometer-screw type fine adjustments. Body has locking device.
- **Three Illuminators:** sub-stage, surface and vertical, have variable intensity.
- **Combination Stage:** rectangular ball bearing with linear measurements to 0.0001" and rotary measurements to 5' with vernier. (Metric model available on special order.)
- **Depth Indicator:** measures in units of 0.0001" by "optical contact" with specimen.
- **Projection Screen:** available as accessory for optical comparison.
- **Eyepiece Turret:** available as accessory for measuring surfaces, radii, thread pitch etc.

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Profiling Tool Inserts Are Double-Locked

Positive locking of the insert and dial adjustment of the chipbreaker are the two major features of this profiling tool. The carbide insert is locked in two places: against the two walls of the tool recess by an eccentric or cam pin through a center hole in the insert and in its seat by a top clamp held by a

socket head capscrew. The insert will not be pulled out while backfacing or contouring. The chipbreaker is raised by a spring plunger when the clamp is released to change, index or invert the insert. Diamond-shaped inserts have a 55-deg nose angle and are set in the holder at a 5-degree negative side and back rake to provide four cutting points. The insert is pulled away from the recess walls when the cam pin is loosened by a wrench on the bottom of the toolholder. Three styles of holders that meet most machine tool requirements are available.

Kennametal Inc. **Circle 457**

Solid Carbide Drills Cut Space-Age Metals

This line of solid carbide Hi-Ten drills, series 1806, is suited for drilling high tensile alloys and steels. Available in 29 fractional sizes graduated in 1/64-inch increments from 1/16 to 1/2 inch, they drill hardened steel to R_C 65 and exotic metals, high-tensile alloys and

high-temperature alloys to R_C 56. Solid carbide throughout, they have straight shanks and two straight flutes. They are right-hand cutting.

Atrax Co., Newington 11, Conn. **Circle 458**

Finishing Machine Has Index, Continuous Drives

Because it can be converted from rotary indexing to continuous rotary motion in less than one minute, this rotary polishing and buffing machine can be used for finishing operations on a variety of parts on both long and short production runs. It has individual

motors for the index drive, continuous drive and the spindle drive. A timer control permits variable index speeds and the continuous table drive and spindle drive are both equipped with a 3 to 1 ratio variable speed unit. The

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machine is available in a 5½-ft-diam size with a 7-station index; an 8-ft-diam size and 8-station index; and a 10-ft-diam size and 12-station index. Polishing lathes are positioned around the periphery of the table. The 7-station, 42-spindle machine illustrated polishes and buffs die cast automotive hardware parts at a production rate of 1500 parts per hour.

Acme Mfg. Co., 1400 E. Nine Mile Rd., Detroit 20, Mich. **Circle 459**

Electrolytic Spindle Operates at High Amperage

Pictured is the Anocut spindle for operation at 3000 amp. This spindle and a second model for operating at 50 amp are two of a large number and variety of motorized and belt driven

spindles arranged for electrolytic grinding at all amperages between 50 and 3000. Insulation is built in and the spindles are equipped with a fork type brush assembly for cool operation.

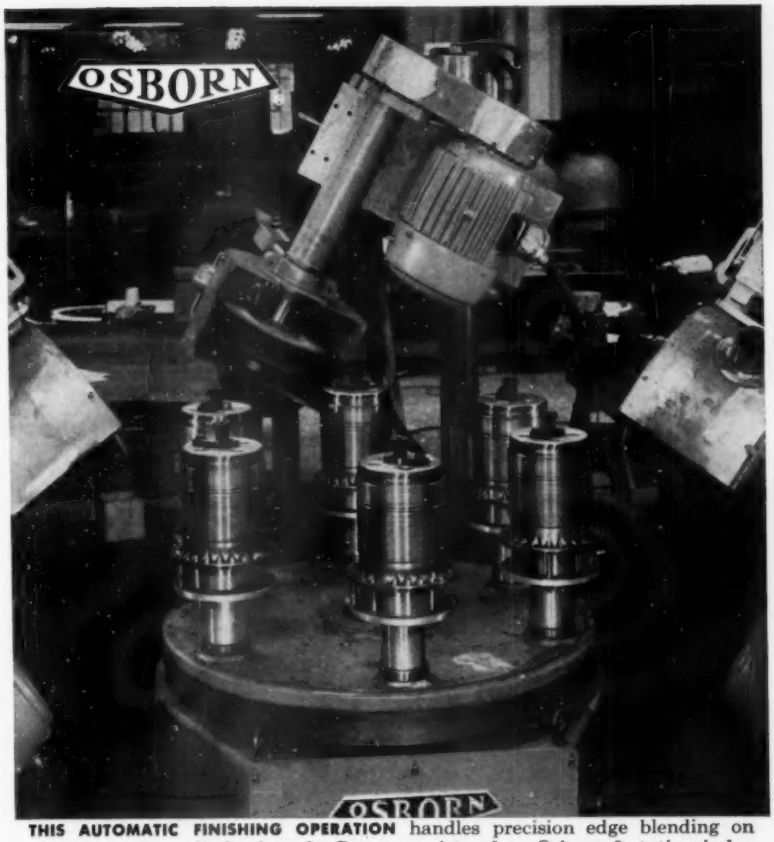
Pope Machinery Corp., 261 River St., Haverhill, Mass. **Circle 460**

Hand Operated Tapper for Light Work

This pneumatically operated tapper is primarily designed for light tapping work in the sheet metal field. A pistol design tool for easy hand operation, Model 400-T tapper, complete with tapping chuck, weighs 3 lb.

Operating at 400 rpm, the spindle normally runs in a forward or right hand direction, but the cutting direction of the tapper can be reversed by squeezing the reverse button in the handle. Releasing the button actuates the forward movement again. Air power is controlled by the on-off valve located in the pistol grip handle.

Capacity of the tool is No. 10 to 5/16-inch USC or USF, and best results are



THIS AUTOMATIC FINISHING OPERATION handles precision edge blending on aircraft engine cylinder barrels. Setup consists of an Osborn 6-station index table and three finishing heads equipped with Osborn Fascut® Brushes with deburring compound. Heads No. 1 and 3 each brush one minute clockwise and ccw to put .020" blend on edges of mounting holes. Head No. 2 brushes 1½ minutes cw and ccw to put .010" blend on top edge and O.D. thread ends.

EDGE BLENDING cylinders

done 566% faster with OSBORN power brushing

Here's an aircraft manufacturer with a problem: specifications for these reciprocating engine cylinder barrels called for precision tolerances. Hand finishing rate: 3 parts an hour . . . too slow . . . too costly.

Today, an automatic Osborn Metal Finishing Machine handles the work . . . *power brushing* the parts rapidly, uniformly, economically. Rate: 20 an hour . . . *566% faster with exceptional quality control.*

It's another case-in-point of today's Osborn power brushes and brushing methods at work throughout industry solving tough metal finishing problems. An **O**sborn **B**rushing **A**nalysis—made in your plant now at no obligation—can cut costs on *your* deburring, cleaning, polishing and precision blending operations. Write or call *The Osborn Manufacturing Company, Dept. K-67, Cleveland 14, Ohio. Phone ENdicott 1-1900.*

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Power, Paint and Maintenance Brushes • Foundry Production Machinery

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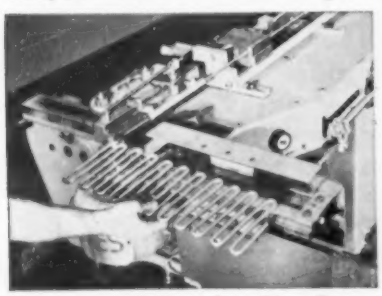
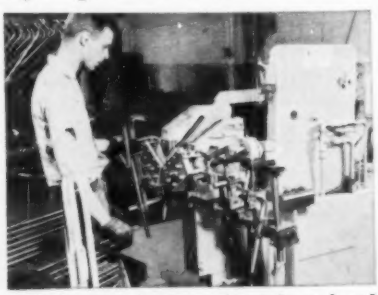
YOU CAN SAVE BY BENDING!

By production bending the "Pines-way," hundreds of metalworking plants are now benefiting from the cost-cutting advantages of cold-bending tubing, pipe, extruded or rolled shapes into parts similar to those above. Parts are produced faster, with smooth, strong bends. This means improved product quality at reduced costs.

A wide range of bending on large or small work, long- or short-run jobs, is easily accomplished by a complete line of standard Pines Bending Machines. Hydraulic power and automatic operation provide maximum accuracy, efficiency, and economy. Find out today, without obligation, how these machines can produce your parts at less cost.



Serpentine coil formed on Pines Rotary Machine at 900 bends an hour with 8% material savings, reduced assembly costs.



Tubular steel furniture frame is produced on a Pines Bending Press at the exceptional rate of over 2000 bends an hour.

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TOOLS of today

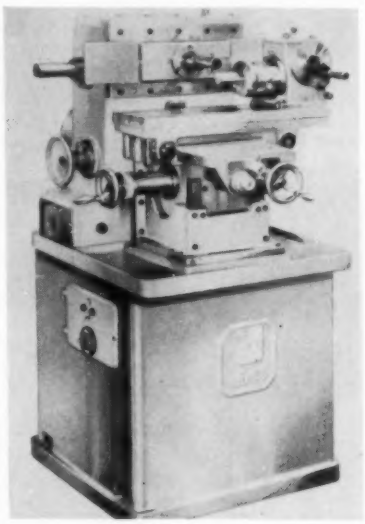
achieved by using two flute gun taps. Noise level is held to a minimum through use of a muffled motor. All internal parts are made from alloy steel.

Airetool Mfg. Co., Springfield, Ohio. **Circle 461**

Tilting Table Top Handles Contoured Punches

Redesigning the table top of the K-15 form and punch shaper has made it possible to tilt the workpiece to as much as 25 deg upward and to a maximum 10-deg swing downward. Formerly, there was no vertical angular adjustment of the table.

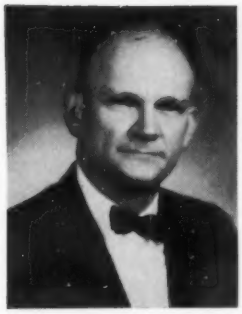
The unit automatically machines the entire workpiece in one setting without



reclamping. It machines tapered punches as well as contours and angular radii with a tolerance of ±0.00025 inch. For optical control over each operation, a projector mounted on the machine magnifies the workpiece 20 times.

The model has speeds of 50, 75 and 110 spm with adjustable stroke length from zero to 6 inches and an adjustable work area to 6 x 6¼ inches.

Jersey Mfg. Co., Livingston St., Elizabeth, N. J. **Circle 462**



F. Steele Blackall III

U. N. Alloy Steel Corp. has announced the election of M. L. Ross as executive vice president. Ross will retain his present operating responsibilities as director of sales at the company's Boston executive offices.

RICHARD O. DRISKELL (pictured) has been named to the board of directors of Exact Engineering & Mfg. Co., Inc., Oceanside, Calif. A graduate of Rose Polytechnic Institute and former electronic group engineer for Convair, he is currently a management consultant.

Richard O. Driskell

Men at Work

New president of Taft-Peirce Mfg. Co., Woonsocket, R. I., is F. STEELE BLACKALL III (pictured). He succeeds his father, FREDERICK S. BLACKALL, JR., who becomes chairman of the board, treasurer and chief executive officer of the company. Associated with the company since 1949, Blackall is Rhode Island chairman of the New England Council, past chairman of the Providence section of the American Society of Mechanical Engineers, vice chairman of the American Standards Assn. committee on the standardization of small tools and machine tool elements and a member of National Machine Tool Builders Assn.

Recently named chairman of the board of Atlas Copco, Inc., New York, is HOWARD G. SHEPERD. At the same time, PETER REDPATH was elected president. Atlas Copco, Inc., was formed at the beginning of the year by merging Atlas Copco Eastern and Atlas Copco Pacific. C. E. BURTON, formerly vice president of Atlas Pacific, has been named executive vice president for the new organization and will continue to operate the San Carlos, Calif., office. Also named to an executive position was R. G. CHAMBERS, vice president in charge of the Eastern Div. He comes to the U. S. organization after 10 years with Atlas Copco Canada where he served most recently as western superintendent in Vancouver. Chambers will headquarter in Paramus, N. J.

Executive realignments made by Standard Screw Co., Bellwood, Ill., involved three new vice presidents and general managers (pictured). Chicago Screw Co. Div. is now under the supervision of PAUL A. MONGERSON, formerly vice president and assistant to the chief executive officer. MICHAEL J. PERRIN will head Hartford Machine Screw Co. following several years as vice president of manufacturing of this division. New head of Standard's third division, Western Automatic Machine Screw Co., is THEODORE R. PLEINES. Prior to this appointment, Pleines was factory manager and assistant general manager.

In his new position as vice president of operations, JAMES T. SIMMONS will have direct responsibility for sales, engineering and manufacturing of all Hudson Wire Co. divisions. During the past nine months while general manager of the Ossining, N. Y., division, he made a number of improvements in products, packaging and manufacturing. He joined Hudson in 1959 as plant manager. Earlier, he was supervisor of manufacturing methods at General Electric Co.'s wire and cable facilities in Lowell, Mass., and a management engineer with Bigelow, Kent, Willard & Co. of Boston and New York.

A veteran of more than 25 years in the steel industry, CHARLES W. SCHUCK (pictured), in his dual post as executive vice president and chief operating officer of Braeburn Alloy Steel Corp., will have responsibility for every facet of the Continental Copper and Steel Industries, Inc. division. He was formerly in charge of production and research at the Braeburn, Pa., plant. Since joining the firm in 1940 as a metallurgical engineer after serving in a similar capacity with other major steel companies, he has held virtually every position in the division concerned with the development and production of its special steels.

New Yoder Co. vice president in charge of engineering and vice president in charge of sales are EUGENE L. MACKEY and ELMER A. KOENIG. Mackey began his service with the Cleveland company in 1935 as a draftsman and became chief draftsman in 1947, assistant chief engineer in 1952 and director of engi-

Paul A. Mongerson

Michael J. Perrin

Theodore R. Pleines

Charles W. Schuck

neering in 1955. Koenig joined the sales department in 1945 and was subsequently named assistant sales manager, sales manager and director of sales.

C. B. BLACK, executive vice president and a director of Rockwell-Standard Corp., Coraopolis, Pa., has been elected a director of Aero Commander, Inc. The wholly owned subsidiary is located at Bethany, Okla.

Following 11 years of service in various capacities, EDMUND W. HOLLISTER, manager of Austin Co.'s 12-state Cleveland district, has been elected a vice president. He joined the organization as an equipment engineer in 1940 and. in 1943, was placed in charge of design of all mechanical installations at the $50,000,000 Chicago Army aircraft plant. He was appointed district engineer of the Cleveland district in 1947, assistant district manager in 1958 and district manager in January 1960. A registered engineer in 30 states, he is a member of the National, Ohio and Cleveland Society of Professional Engineers and the Cleveland Engineering Society.

Several organizational changes in the sales and technical service staffs have been announced by Corhart Refractories Co., Louisville, Ky. One change involved HAROLD W. BAQUE who was named vice president and assistant to the president. Appointed vice president and general sales manager is JOHN K. MEYER. Baque, with the company since 1930 when he joined the firm's sales staff, will assume a variety of assignments with immediate interests focused on international business. Meyer joined Corhart in 1938 as a plant engineer and, after serving in various production posts, was named a vice president in 1955. He was appointed manager of metallurgical sales in 1957.

WILLIAM E. ATCHLEY (pictured), who joined National Twist Drill and Co., Rochester, Mich., in 1943, was recently elected vice president in charge of sales. First a salesman, he subsequently served as district sales manager, assistant general sales manager and sales manager. He is a graduate of Syracuse University.

William E. Atchley

Appointment of JOHN D. GOODELL as president and general manager has been announced by USI Robodyne Div., Silver Spring, Md. In his previous post as director of engineering, he was concerned with the development of industrial automation equipment. Prior to his association with the firm, he was manager of new product development for the CBS Laboratory in New York City and for Brown & Bigelow, Minneapolis.

Election of GUS KEULEMANS as executive vice president has been announced by American Screw Co., Willimantic, Conn. Keulemans, who has spent his entire career in the metal fabricating industry, was at one time associated with Bell Telephone Mfg. Co. in their largest European division.

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GORDON MOOS (pictured) has been elected vice president in charge of the fastener division of Spiron, Inc., Silver Spring, Md. He will be in charge of all fastener sales and merchandising, new product development and government and industry standardization programs. His former post was with Waldes Kohinoor, Inc. as vice president in charge of sales and production.

Gordon Moos

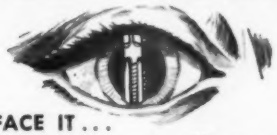
New vice president of marketing for the Diehl Mfg. Co., Finderne, N. J., is JAMES J. ANDERSON. Before joining Diehl, Anderson was vice president of the Holtzer-Cabot Div., National Pneumatic Co., Inc., of Boston. ROY BOOTH, predecessor of Anderson, was appointed New England regional manager. Booth, with the Diehl Sales department for 35 years, had been named New England district manager in 1943 and, in 1956, was appointed vice president in charge of sales.

HERBERT J. COOPER succeeds HARRY A. COOPER as president and chief executive officer of Cooper Alloy Corp., Hillside, N. J., and its subsidiary, Vanton Pump and Equipment Corp. Since joining the corporation in 1948 as research engineer, Cooper has held varied executive positions including that of foundry superintendent, plant manager and executive vice president.

HOWARD T. CHRISTANSON has been named president of Machinery Sales Co., Los Angeles, Calif. NATHAN TROOP was elected vice president and treasurer and KIMBALL SMITH, vice president and secretary. Christanson joined the firm in 1941 as manufacturing division manager and Troop was an officer with the company at its inception. Smith joined the firm to take the new post following 18 years in the California machinery distributing business.

JORDAN JABLONS was elected executive vice president of Schwarzkopf Development Corp., New York. He was previously associated with John Chatillon & Sons and with American Coldset Corp.

THERE'S MORE TO TAPS THAN MEETS THE EYE!



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They will look alike, measure alike . . . they are made of quality steel. With this apparent similarity . . .

. . . THEN WHAT ARE THE IMPORTANT POINTS TO CONSIDER IN SELECTING TAPS?
Selecting the *right tap for the job* is vitally important for top tap performance. Regardless of its quality, the wrong tap cannot do the job properly. And, as you know, poor tap performance can be costly.

3 KEY POINTS TO REMEMBER
The differences in ground thread taps become apparent in their performance. The key to proper tap selection lies in these three critical areas:

1. Selecting the correct tolerance with respect to tapped hole limits.
2. Selecting the correct type of chamfer, chamfer relief, flute contour and pitch diameter relief.
3. Selecting the style of tap as regards number of flutes, or whether it should be spiral pointed or spiral fluted.

HOW TO GET HELP FOR PROPER TAP SELECTION
Jarvis has gone to great lengths to make tap specifying information available. The new Jarvis Tap catalog has a complete section devoted exclusively to engineering information and guidance for tap selection. Also, Jarvis offers its now-famous, handy pocket-size Tap Selector Guide. Both are free for the asking.

In addition, Jarvis sales-engineers are always ready to help solve your tapping problems.

THERE IS A BIG DIFFERENCE IN TAPS AND IN THEIR PERFORMANCE. YOU CAN PROVE THIS TO YOURSELF BY DEPENDING ON JARVIS THE NEXT TIME YOU ORDER TAPS.

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- Jarvis Pocket-Size Tap **Selector Guide**

JARVIS TAP-OF-THE-MONTH

JARVIS PIPE TAP

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5 JARVIS TAP FACTS

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Field Notes

Research engineers in the field of metal processing are eligible to compete for the **F. W. Taylor Medal.** Awarded by the **College International pour l'Etude Scientifique de Techniques de Production Mechanique,** the medal will be given on the basis of unpublished research papers. Entrants, who must be less than 35 years of age but can be of any nationality, may enter by submitting their papers to any member of CIRP. A list of members in the United States will be supplied upon request. The paper cannot be based on a doctor's thesis.

acquisitions

Thor Power Tool Co., Aurora, Ill., has bought sole control of Italy's largest manufacturer of air tools. The Italian firm, **FIAP,** is located in Turin and employs approximately 225 people. Thor has also acquired a substantial minority in a Spanish company, **FIAP Espanola,** located in Barcelona, Spain.

The business formerly conducted by **Kidde Precision Tool Corp.,** Roseland, N.J., has been sold to a newly formed company, **KPT Mfg. Co.** Joseph W. Mollek, Jr., executive vice president of Kidde, and Mr. John R. Evans, assistant treasurer of the Walter Kidde subsidiaries, will be president and treasurer, respectively, of the new company. L. K. Herndon, senior vice president of Techno Fund, Inc., Columbus, will be chairman of the board. The management of the new company will retain the present operating personnel and will continue to occupy the existing plant facilities.

Raytheon Co. directors have approved acquisition of the stock of **Trans-Sil Corp.,** Englewood, N. J., manufacturer of silicon rectifiers. The acquisition has been approved by **Food Machinery Chemical Corp.,** the principal owner, and the other stockholders. Trans-Sil's semiconductor product line complements Raytheon's own solid state business.

association news

John W. Douglas, president of Republic Foil, Inc., Danbury, Conn., was elected president of the **Aluminum Assn.** at its recent annual meeting. M. M. Anderson, executive vice president of Aluminum Co. of America, who preceded Mr. Douglas as president, was elected chairman of the board of directors. Arthur V. Davis was re-elected honorary chairman of the board. Irving Lipkowitz, Reynolds Metals Co.; Louis Lippa, Apex Smelting Co.; and D. A. Rhoades, Kaiser Aluminum and Chemical Corp. were elected directors-at-large for three-year terms. Two association vice presidents were elected. They are Richard L. Allen, Bridgeport Brass Co., and Mord Lewis, Anaconda Aluminum Co. N. H. Collisson, Olin Mathieson Chemical Corp., was re-elected vice president.

The **Society of Die Casting Engineers** has elected as its president John L. MacLaren, Detroit sales engineer of Aluminum Ltd. Sales, Inc., New York. Other officers for 1961 are vice president, Earle W. Rearwin, chief product engineer of die casting machines, Reed-Prentice Div., Package Machinery Co., East Longmeadow, Mass; secretary, M. R. Tenebaum, Detroit sales engineer, Lester-Phoenix Inc., Cleveland, Ohio; and treasurer, Lee G. Axford, manufacturing engineer, Ford Motor Co., Detroit, Mich.

expansions

Arnhold Ceramics, Inc., has announced the formation of a new subsidiary company, **AC Compacting Presses, Inc.,** which will take over the functions formerly carried out by the **Dorst Div.** of the company. The new company will be the exclusive United states and Canadian sales and engineering organization for Dorst presses. Officers of the new company are Henry H. Arnhold, president; Walter Gort, vice president for engineering; H. H. Kundler, vice president for sales; and Helen Reid, secretary.

Valeron Corp., Detroit-based manufacturer of metalcutting tools and carbides, has announced the organization of an overseas affiliate to sell and service its products abroad. To be known as **Valeron S. A.,** the organization has established headquarters at Frieborg, Switzerland, and named Frank Haubner manager of foreign sales and service. An engineering office, staffed with American-trained personnel, is to be maintained overseas for the purpose of supplying design and consulting services to foreign metalworking manufacturers.

Foreign operations of **Midland-Ross Corp.,** with headquarters in Cleveland, have been extended through a long-term licensing agreement with **Henry Simon, Ltd.,** British engineering and contracting firm. Under the agreement, Simon is granted rights for the manufacture, sales and distribution of the web processing equipment made by Midland's **Waldron-Hartig Div.,** New Brunswick, N. J. Simon has been given rights for handling Waldron's coating, embossing, laminating, saturating and web handling equipment in certain countries of the British Commonwealth as well as in Western Europe.

G. T. Brennan, vice president and general manager of **Vascoloy-Ramet Corp.,** Waukegan, Ill., has announced the formation of **Vascoloy-Ramet (Europa) N.V.** The new company plans to break ground in the near future for the construction of a $250,000 manufacturing facility in Zwolle, Holland. Manufacturing at the plant will consist of compacting, forming, sintering and grinding of cemented carbide blanks, inserts and other carbide products from blended powders imported from the Waukegan plant. Managing director of the plant will be A. J. VanSchooneveld of Amsterdam.

Formation of **Precision Metal Processing Co.,** incorporating as a division, **Kold-Lube Coaters, Inc.,** has been announced by Earnest Harwell, president of the Cleveland-based firm. The company is headquartered in a modern 50,000-sq ft building.

A furnace processing plant has been opened in San Antonio, Texas, by **Stainless Processing Div., Wall Colmonoy Corp.** It houses high-production pit type furnace facilities which will handle parts to 28 inches in diameter by 35 inches high. Named manager of the new plant is L. E. McIlvain.

The first affiliated company under a corporate expansion plan is operating in Hawthorne, N. J., where J. E. Johnson, former Nylok vice president of engineering, has set up **Aerospace Nylok Corp.** and has taken out the standard licensing agreement with **Nylok Corp.,** Paramus, N. J. Aerospace Nylok will manufacture self-locking threaded fasteners for the aircraft, missile and electronic field.

The merger of **Jack & Heintz, Inc.,** into **Siegler Corp.,** Los Angeles, combines Siegler's capabilities as a manufacturer of military and commercial

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Field Notes

electronics and aerospace components with those of Jack & Heintz in missile, aviation and industrial fields. No changes are planned for present Jack & Heintz management, employees or facilities. The merger forms a company with annual sales of approximately $100,000,000.

moves

Bruce Schafer, manager of the **Detroit Electric Furnace Div., Kuhlman Electric Co.,** has announced the division's move from Bay City to Detroit. The division will be housed in a part of the new plant recently acquired by the parent company at 11405 E. State Fair Ave.

Sandvik Steel, Inc., has moved its Chicago branch office into the company's new building located at 7520 N. Long Ave., Skokie, Ill. Operations in the 16,428-sq ft office and warehouse were begun on Feb. 1, 1961.

The **Research Div.** of **Sciaky Bros., Inc.,** will be transferred from Los Angeles to a plant in Chicago in the near future. This move is being made to centralize and integrate research and development work with the main plant's laboratory and manufacturing facilities.

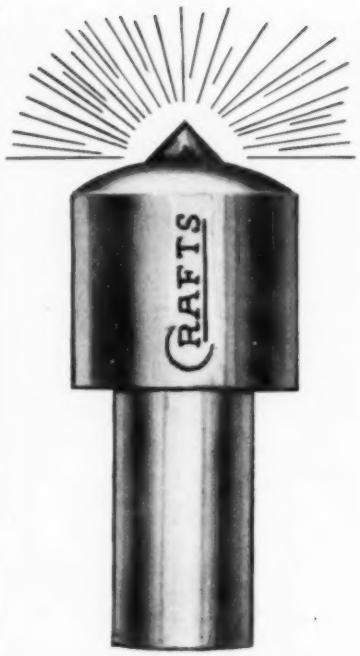
Rezolin, Inc., recently moved to expanded facilities at 35640 S. Gratiot Ave., Mt. Clemens, Mich. Under the direction of Ralph Kaisch, northern sales division manager, Rezolin makes formulated plastic compounds for plastic tooling, electrical insulation, adhesives and specialty compounds for the building industry.

Diebel Die & Mfg. Co. has moved its operations recently to its newly completed plant in Morton Grove, Ill. The plant has 35,000 sq ft of floor space in its single story layout. Contract manufacturer of complex parts and mechanisms for the electrical and electronic industries, Diebel was formerly located on Chicago's northwest side.

Nebel Machine Tool Corp. has moved its manufacturing, engineering and purchasing operations to Hamilton, Ohio, where it is already building its line of lathes and shapers.

awards

G. Palmer Humphrey was awarded the President's Cup by the **Society of Plastics Engineers** for "outstanding and meritorious service to the society during 1960." This award, presented at



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SPE's annual banquet in Washington, D. C., was made in recognition of Humphrey's service as chairman of the section's committee and for his efforts in compiling a monumental operational manual for the society's 45 sections. He is vice president of R. C. Molding Co., New Hyde Park, N. Y.

new facilities

Ultrasonic Industries, Inc., has relocated to Engineers Hill, Plainview, Long Island, N. Y. The company's new 18,000-sq ft facility on two acres is quadruple the space formerly occupied in Albertson, Long Island, where the company was founded in 1959. National sales headquarters of the company as well as engineering and manufacturing departments are located in the building. **Robot Metalcraft Corp.,** a subsidiary specializing in precision sheet metal fabrication, is also integrated in the operation.

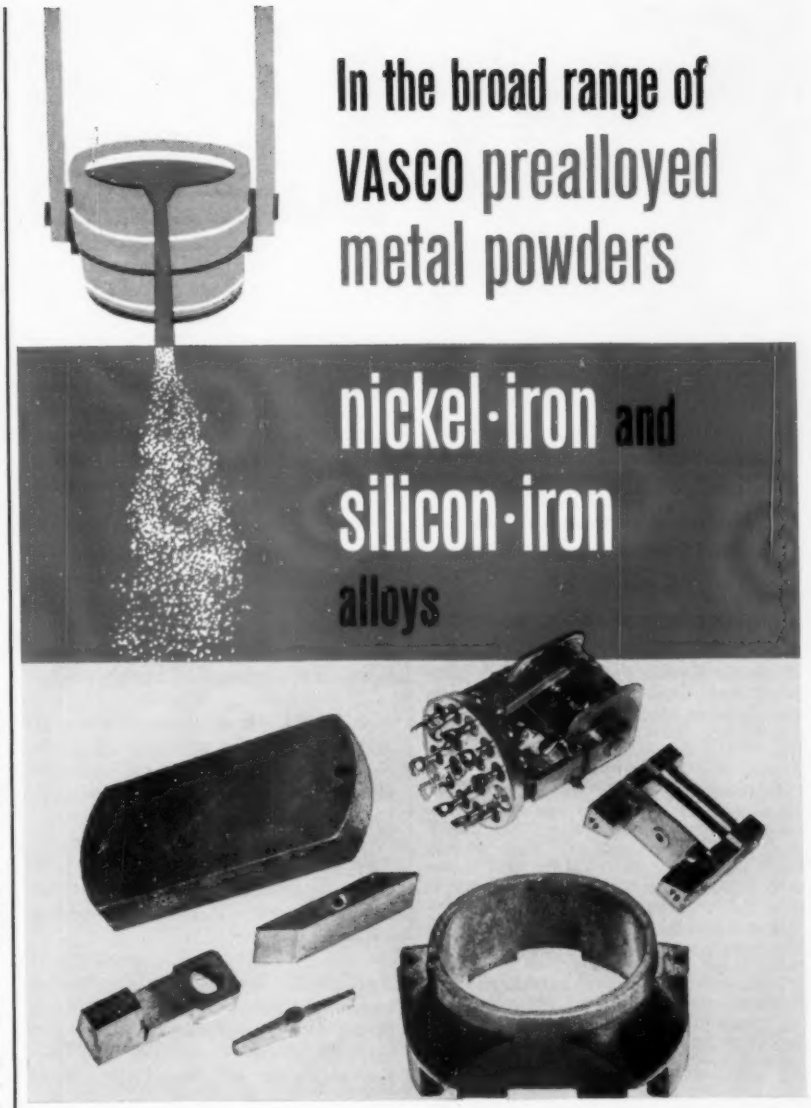
new companies

Fleming Industries, Inc., has been established to undertake design, development and manufacture of electronic ordnance components and equipment. In introducing the new organization, Walter H. Fleming, president, said that the firm will work in the field of integrated electronic-explosive systems. F. M. Cummings is vice president in charge of operations and W. G. Blodgett is chief engineer. The firm, a California corporation, is located at Torrance.

new activities

Formation of a metals department in **Dow Chemical Co.** has been announced by H. D. Doan, executive vice president. W. J. Rave, manager of magnesium production in the Texas division, has been named manager of the department. The department will pull together and be responsible for various Dow activities in magnesium and other primary metals. This includes the development of primary magnesium for die casting, chemical uses of magnesium and other metals.

A $23,000,000 plant for turning low-grade ores into high-quality copper without a melting step anywhere in the process is to be built in the Philippine Islands, according to a joint announcement by **Foster Wheeler Corp.** and the **E. W. Bliss Co.** Foster is prime contractor for the project and Bliss will furnish its patented rolling and fabricating equipment for converting powder into strip. Also scheduled to participate are **Chemetals Corp.,** N. Y., and **Sherritt Gordon Mines, Ltd.,** Toronto.



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who's meeting and where

Apr. 4-6. Conference on electromagnetics and fluid dynamics of gaseous plasma. Sponsored by the POLYTECHNIC INSTITUTE OF BROOKLYN, the INSTITUTE OF THE AEROSPACE SCIENCES, the AIR FORCE OFFICE OF SCIENTIFIC RESEARCH, the OFFICE OF NAVAL RESEARCH and the U. S. ARMY SIGNAL CORPS. Auditorium of Engineering Societies Bldg., New York City.

Apr. 5-7. INSTITUTE OF ENVIRONMENTAL SCIENCES. Annual meeting and equipment exposition. Theme of the meeting is "Global and Space Environments—A Challenge to Industry." Sheraton-Park Hotel, Washington, D. C.

Apr. 10-21. International Institute of Welding with AMERICAN WELDING SOCIETY as host. Sheraton Atlantic Hotel, Commodore Hotel and New York Coliseum, New York City.

Apr. 11-13. AMERICAN SOCIETY OF LUBRICATION ENGINEERS. Annual meeting. Bellevue-Stratford Hotel, Philadelphia, Pa.

Apr. 14-15. Aerospace manufacturing technology seminar. Jointly sponsored by the AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS and the UNIVERSITY OF ARIZONA. University of Arizona, Tuscon, Ariz.

Apr. 18-19. AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS. Process planning and operations research seminar. Statler Hilton Hotel, Cleveland, Ohio.

Apr. 20-21. SOCIETY OF THE PLASTICS INDUSTRY, INC. Eighteenth annual Western Section conference. Hotel del Coronado, Calif.

Apr. 23-26. AMERICAN WELDING SOCIETY and AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Conference on metals engineering. Pennsylvania Sheraton Hotel, Pittsburgh, Pa.

Apr. 26-27. Technical conference on high-temperature materials. Sponsored by the AMERICAN INSTITUTE OF MINING, METALLURGICAL AND PETROLEUM ENGINEERS and the METALLURGICAL SOCIETY. Carter Hotel, Cleveland, Ohio.

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Bonding Ceramic Tips

Two Russian engineers, A. V. Rudney and V. V. Sokolovskaya, have tested the use of adhesives to bond ceramic cutting tips to tool shanks. Their article appears in *Stanki i Instrument*, Vol. 31, No. 8, p. 33 ff. The English title of their article is "Fixing Ceramic Cutting Tips with Heat and Vibration Resistant Adhesives."

The authors tried out phenol-rubber compositions, and cold and hot setting epoxy resin adhesives. (The adhesives are identified as Russian compositions VS-10T, VS 350, VK 32-200 and ED 6.) All of these adhesives are nontoxic. Standard vibration tests were used to determine the effectiveness of bonding. Joint strength was tested on a Riehl machine and temperatures in the bonded area were measured by copper-Constantan thermocouples, 0.007-inch diameter.

Using the adhesive-bonded tips, uninterrupted cuts were made on steel at a speed of 984 fpm. Interrupted cuts were made at 328 fpm. Some of the tests were run with shanks having a recess in which the tips were mounted; in other tests shanks without recesses were employed. The authors found that the bond was not strong enough to withstand cutting stresses unless the tip was recessed in the shank. They also found that the adhesive-bonded tips could readily be reground. The maximum temperature of the adhesive during cutting was 250 F. To remove the tip, a temperature of 750 F is needed. The shank can be re-used after sandblasting.

Adhesive bonding is done in three steps. First the surfaces of the shank and tip are prepared by sandblasting, followed by degreasing in an organic solvent such as acetone, benzene or dichlorethane. The solvents are applied with a brush.

After cleaning, the surfaces are initially dried in a cabinet equipped with a vent to draw off fumes. Further drying takes place in a room kept at 65-75 F and at less than 80 percent relative humidity. Adhesive is applied in two layers, using a soft brush. Strokes are made only in one direction in order to prevent the formation of bubbles. Each layer of adhesive should be no more than 0.003 inch thick. After the first layer of adhesive is applied, it is allowed to set for 15-20 minutes before the second layer is applied.

Twenty minutes afer the second layer of adhesive is applied, the tip is put in position on the shank. Light pressure is used to remove small bubbles and to distribute the adhesive uniformly; then a 500-600-psi pressure is applied with a clamp. The tool is next heated to 375-390 F for two hours, then allowed to cool to room temperature. After 24 hours, the tool is ready for use.

Cutting with Ceramics

Use of ceramic tools on older machines should be satisfactory, according to an article by H. Woepkemeier in *Industrie Anzeiger*, Vol. 82, No. 80, 1960, p. 1349-1353. When older machines are statically and dynamically satisfactory from the standpoint of cutting pressures and vibrations, good results should be obtained with ceramics. The title of Woepkemeier's article is "Einsatz de Schneidkeramik in der Fertigung." He recommends cutting speeds two to three time faster than those used with carbide tools under the same conditions.

Cutting Force Dynamometer

Tangential cutting force can be measured during fine boring operations with a new dynamometer developed by S. N. Filonenko and Y. N. Gonchar and described in an article in *Stanki i Instrument*, Vol. 31, No. 9, 1960, p. 39 and 40. The English title of the article is "A Simplified Method for Measuring the Tangential Component of a Cutting Force."

Hobbing Convex Surfaces

With the increase in accuracy required of the components used in modern gear transmissions, methods for the hobbing of convex surfaces on gears have been developed. Gears with this configuration run more quietly and last longer than conventional gears.

Equipment and methods for hobbing convex surfaces is described in an article by H. A. Koop in *Technisches Zentralblatt fuer praktische Metallbearbeitung*, Vol. 54, No. 12, 1960, p. 594-598. The title of his article: "Waelzfraesen von balligen Verzahnungen."

The author believes that further development of convex hobbing methods is inevitable, due to the requirements for gears of this design in aircraft and automotive engines, machine tool transmissions and other applications—bulldozers, for example—where heavy loads may deflect shafts and break gears.

Punching Dies

Swedish investigators have studied the wear of punching dies. Their findings are given by Gunnar Nygran, writing in *Werkstatt und Betrieb*, Vol. 93, No. 12, 1960, p. 777-781. His article is entitled "Verschleiss von Schnittwerkzeugen."

Punch wear starts at the outside diameter in the vicinity of the cutting edge and progresses toward the center and, to a smaller degree, along the outside surface, according to Nygran. Die diameter was about 0.19 inch. Wear was measured by means of a Talysurf 3 instrument or with a microscope.

Two different types of sheet metal were used—leaded carbon steel and stainless steel. Both materials were tested in three different hardnesses. It was found that the composition, microstructure, surface finish and thickness of the workpiece all affected tool wear. The shape of the punch, tool geometry, surface finish, impact speed and lubricant also influence wear. Fast wear resulted when a punching tool with high chrome content was used on stainless steel, as might be expected due to the affinity of the tool and work material.

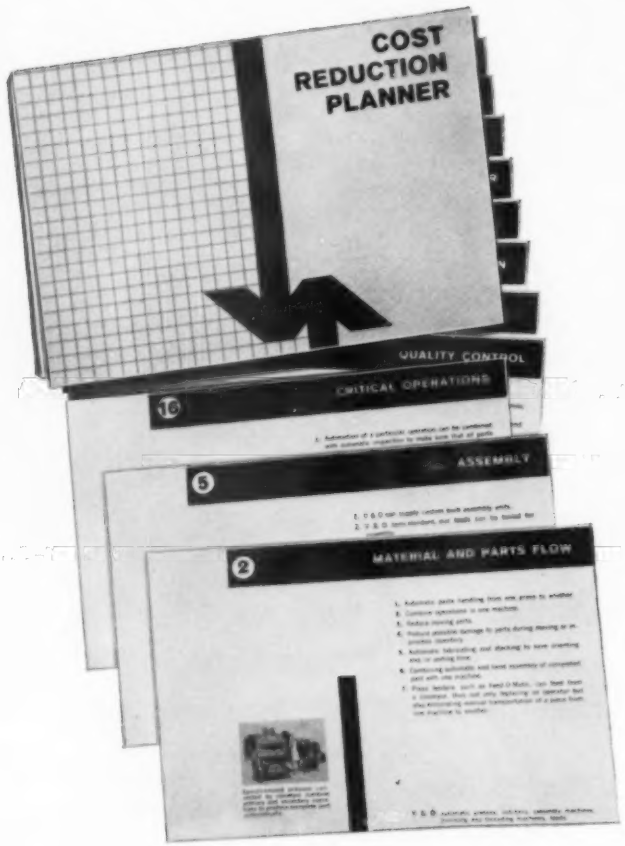
The author discusses tool clearances, differences between heat-treated and annealed materials, and similar variables. The main finding from the tests, which were conducted over a period of several years, is that wear cannot be predicted by comparing the tensile strength of the materials involved.

Molybdenum Lubricant

Molybdenum sulphide is a highly effective lubricant in drilling operations, according to G. Polzin, writing in *Werkstatt und Betrieb*, Vol. 93, No. 11, 1960, p. 709-711. The title: "Der Einfluss von Molybdaendisulfid auf den Standweg von Spiralbohrern."

Molybdenum disulphide, which has a structure similar to that of graphite, provides a film between the drill and the work. During the tests, tool life when using a conventional emlusion was compared with tool life when using 1:10 and 1:5 solutions of molybdenum disulphide. In some tests the twist drills were treated with molybdenum

(Continued on page 157)



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disulphide prior to cutting.

Diagrams published with the article are not fully conclusive, since they do not cover the entire range of cutting speeds. Data presented in tabular form for speeds of 115 and 130 fpm, however, show that tool life was increased 2.06 times when using the 1:10 molybdenum disulphide solution; 2.95 times when using the 1:5 solution and 4.7 times when the twist drills were treated with molybdenum disulphide prior to cutting.

New Measuring Tools

An article in *Werkstattstechnik*, Vol. 50, No. 12, 1960, p. 709-721, surveys recently developed measuring tools. The article, by W. Dutschke, is entitled "Neue Messgeraete fuer Werkstatt und Pruefraum." The author bases his article on measuring tools exhibited at the Hannover and Duesseldorf exposition, where American, British, West German and other instruments were shown.

Among the exhibits that the author found of interest is a measuring fixture for determining the thickness, curvature and twist of turbine buckets at any cross section. It is mechanically-pneumatically operated and can check up to 250 pieces per hour. Readjustment for a different size or type of bucket takes about 30 minutes.

One of the optical instruments exhibited permits the outside diameter of workpieces to be measured without contact. The workpiece can be stationary or rotating. It is measured by two beams of light, opposing each other at 180 degrees. The reflected light beams are picked up by eyepieces equipped with micrometer adjustment.

This instrument can check workpieces having diameters up to 6½ inches. A larger instrument of the same design will check workpieces up to 80 inches in diameter. The micrometer will be replaced by an optical scale in this larger model. Measuring error does not exceed 0.0002 inch.

Another optical instrument described by Dutschke is a depth indicator that does not come in contact with the workpiece being measured. It is used for measuring plane surfaces such as machine tool guideways, comparing them with the surfaces of liquids. Shoulders and recesses can also be measured. Measuring error does not exceed 0.00008 inch.

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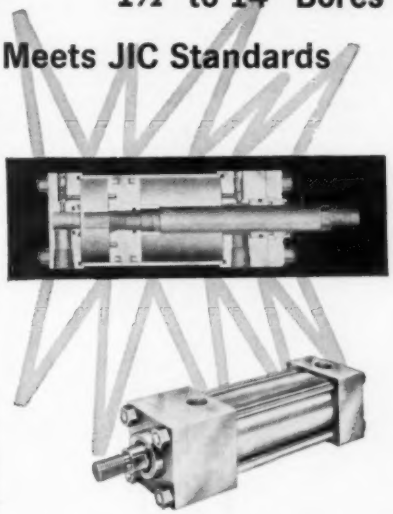

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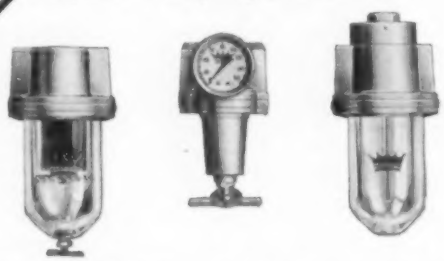

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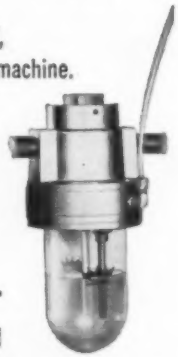

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Engineering Bookshelf

FUNDAMENTAL PRINCIPLES OF POWDER METALLURGY—*By W. D. Jones. Published by Edward Arnold (Publishers) Ltd., London, England. Price $30. 1032 pages.*

Intended primarily as a text for the science graduate, this book discusses in detail the techniques and fundamental principles of powder metallurgy. Methods of manufacturing—chemical reaction or decomposition, electrolytic deposition, mechanical processing of solid metals and atomization of liquid metals—are covered in the first chapter.

Of particular interest to the tool and manufacturing engineer is the chapter on pressing. Shaping without pressing, sintering, the attainment of specific qualities, continuous powder metallurgy and methods of control are the subjects of the remaining five chapters. To give the reader perspective, the author indicates origins and early developments in the field and briefly discusses related subjects, such as the properties and preparation of ferrites, which are not usually regarded as part of the field of powder metallurgy.

Gaps in existing knowledge are pointed out, suggesting areas of investigation. Where pertinent, design problems and cost considerations are included. The focus of the book is kept on the future because—just as powder metallurgy applications are much more extensive now than anticipated a few years ago—the future will, in all probability, bring many more uses in many more fields.

SCREW-THREAD STANDARDS FOR FEDERAL SERVICES, PART III—*Published by the National Bureau of Standards, Washington 25, D. C. Price $0.60. 66 pages.*

This volume—the third in a series of three—covers Acme, Stub Acme and Buttress threads as well as rolled threads for screw shells of electric lamp holders and bases, microscope objective and nosepiece threads, surveying instrument mounting threads and other miscellaneous threads. Representing the work of the Interdepartmental Committee—sponsored by the Departments of Defense, Army, Navy, Air Force and Commerce—the handbook is based on the 1933 report of the National Screw Thread Commission, NBS Handbooks H25 and H28 and standards approved by the American Standards Association.

CHIPLESS MACHINING—*By Charles H. Wick. Published by The Industrial Press, 93 Worth St., New York 13, N. Y. Price $10. 502 pages.*

As material costs rise, the various processes whereby metal is machined without chip formation become increasingly important. Some of these processes — coining, cold heading, press drawing—are well established but others such as explosive forming, internal swaging, spline and gear rolling are comparatively new. In this book all methods of chipless machining are discussed.

Much of the information presented is a review of basic principles. As such it will prove more beneficial to the novitiate than the specialist seeking a depth study of any particular process. Specialists in one field, however, will find it a useful tool in increasing their knowledge of other fields not distantly removed from their own. Perhaps the greatest benefit of this book is that it brings together—for the first time—all pertinent information regarding the relatively new processes of machining without chips.

PRINCIPLES OF ENGINEERING ECONOMY—*By Eugene L. Grant and W. Grant Ireson. Published by The Ronald Press Co., 15 E. 26th St., New York 10, N. Y. Price $8. 572 pages.*

This book explains the principles and techniques needed for making decisions about the acquisitions and retirement of capital goods by industry and government. Emphasis throughout the book is placed on the following two points: It is the prospective difference between alternatives that are relevant in their comparison; and the fundamental question regarding a proposed investment in capital goods is whether the investment is likely to be recovered plus a return commensurate with the risk and with the return obtainable from other opportunities for the investment of limited funds. The purpose of calculations that involve the time value of money should be to answer this question.

The volume is divided into three parts plus appendixes. The first part deals with planning economy studies for decision making. The second part covers interest. The third part discusses techniques for economy studies.

PRESS BRAKE DIES—*Published by Dreis & Krump Manufacturing Co., 7400 S. Loomis Blvd., Chicago 36, Ill. 134 pages.*

Principles of bending and forming dies used in press brakes plus numerous illustrations make this book useful to die designers. It will also prove invaluable to product designers and process engineers since many problems of product design and manufacture are spelled out clearly and concisely.

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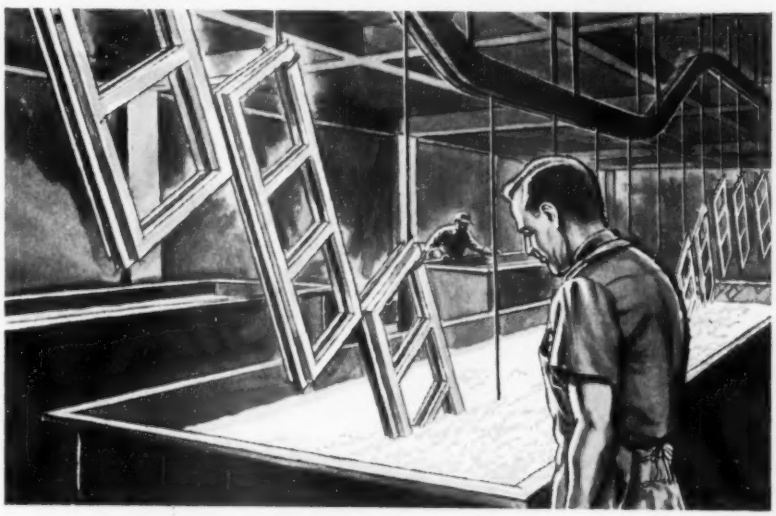

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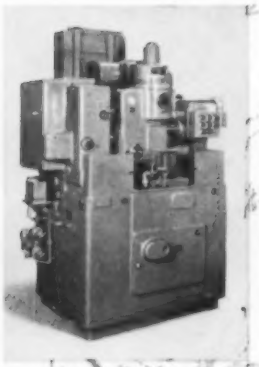

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Spatter-Free Welding: Aircomatic CO_2 Sprayarc, a new process developed by Air Reduction Sales Co. for welding of mild steel, combines the use of carbon dioxide and a low-alloy steel wire to produce a quiet, spatter-free type arc. The open arc provides ease in welding with a visible arc length of approximately ⅛ inch. Typical applications for the process are in tubing, landing mats, die posts, piping, car frames, compressor casings, pressure vessels, farm machinery and machine mountings.

The wire—Airco type A602—can be used for single or multipass mild steel applications with deposition rates varying from 7 to 15 lb an hour. Tensile tests show a maximum tensile strength of 70,000 psi and a yield strength of 60,000 psi.

Analysis of Brass: By careful analysis of the forming properties and grain structure of a thin gage brass, Buglecraft, Inc., has increased production of one of their products more than 1300 percent.

A fine grain brass originally selected for the product components—an inner coil, an outer coil and a cover—offered excellent forming and plating characteristics. Complete joining, however, was slow and frequently unpredictable since the solder tended to flow rather than wet the metal at the joints. Slightly different spring characteristics of the thin-gage inner coil often caused the coil to separate from the outer coil during the soldering operations.

By selecting a large grain size brass—0.080 mm—strip recommended by Bridgeport Brass Co. for the outer coil stamping and by controlling the fit of the inner coil with a medium-soft brass strip—0.030 mm grain size—a precise fit has been achieved and scrap loss has been practically eliminated.

Liquid Nitriding Process: Equipment for a liquid nitriding process which results in tough, ductile, wear-resistant surfaces and increased fatigue strength —without a brittle white layer—is now being made by Kolene Corp. Developed in Germany, Tufftriding can be applied to low carbon, alloy, stainless, tool and heat-treatment steels as well as grey, alloy, nodular or ductile, malleable and pearlitic irons. If there are no residual stresses prior to treating, distortion and growth are negligible.

Fatigue life of low-carbon steels is increased with this process as much as 80 percent; medium-carbon steels, 60 percent; 18-8 type stainless steels, 35 percent; grey cast iron, 20 percent; and malleable iron, 43 percent. These improvements alone suggest the substitution of lower cost materials, a redesign for weight savings or the elimination of fatigue failure on parts currently in production, such as ball joints, gears, thrust washers, steering components and crankshafts.

Modified Martempering: Modified martempering in oil at 260 F has made it possible for an aircraft pump manufacturer to hold closer tolerances on intricate parts and to use less grinding stock due to improved warpage control. Heat-treating equipment making up this installation, manufactured by Surface Combustion Div., Midland-Ross Corp., consists of a martempering bath, two alloy muffle furnaces, an RX gas atmosphere generator, a signaling controller and a dew point recorder. In addition to advantages of prolonged oil life and fewer rejects, this treatment allows the parts to achieve better structure stabilization in a deep freezing step.

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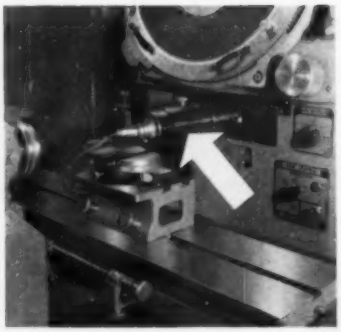

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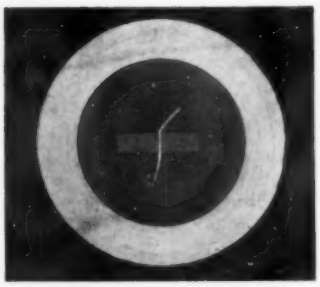
CENTRALITE image of read/record head clearly shows two magnetic poles separated by aluminum foil insulator at 31.25 magnifications.



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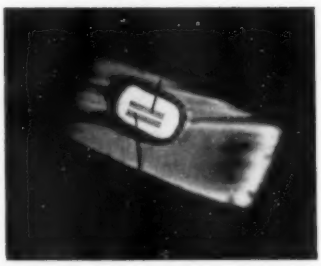
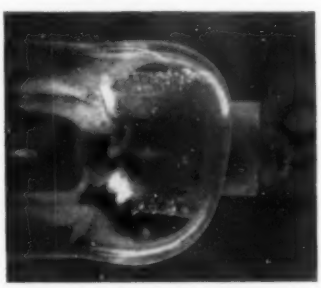


Micro inspection of this mesa diode assembly at 100 magnifications is clearly detailed with CENTRALITE.



PARABOLITE makes possible a sharp close-up of bubble configuration at the fusion point of this tunnel diode (50 magnifications).

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Trade Literature

for free booklets and catalogs—use request card, page 135

REVISED "Summary of Steel Castings Specifications" includes a major change in Federal Specification QQ-S-681. Several new classes have been added to specification A-296 and the property values have been changed on some classes in specifications A-297 and A-351. Two new methods of testing applicable to steel castings have been adopted and are included in the summary. Steel Founders' Society of America. **(Circle 501)** . . . Nozzle-mixing, buried blast burners are designed for sealed or tight combustion chamber applications such as ceramic firing, process heating, ferrous and nonferrous metal-melting or heat-treating, billet heating and other processes. Nine burner sizes with 54 maximum firing capacities from 60,000 to 14,500,000 Btu/hr are listed. Eclipse Fuel Engrg. Co. **(Circle 502)** . . . Two reports—"Distribution Primary Radial Circuit Calculations" and "Power Network Load Flow"—describe two electricity distribution programs for an electronic digital computer. Bendix Computer Div. **(Circle 503)**

Automation, Mechanization

Two or three axis control for single or multiple spindle machines is provided by a numerical control system. National Automatic Tool Co. **(Circle 504)** . . . A system for conveyor material handling control enables one man to direct a fast flow of material to specific stations. Control Design & Fabricate, Inc. **(Circle 505)** . . . Microminiature timing modules make mounting simple and save space on mounting panels. G-V Controls Inc. **(Circle 506)**

Bending

A bulletin covers a line of production bending machines using the compression method of bending and discusses various types of bending and the economics of bending. Pedrick Tool and Machine Co., Inc. **(Circle 507)**

Boring, Drilling, Tapping

"Fosmatic Precision Boring" describes how jig borers can be equipped with tape control in three axes, giving them full numerical depth control as well as positioning control. Fosdick Machine Tool Co. **(Circle 508)** . . . Drill bushing sizes are presented with the recently adopted American Standards Assn. nomenclature and uniform symbol system. Ace Drill Bushing Co., Inc. **(Circle 509)** . . . An electrolytic high-speed steel drill sharpener makes possible relative combinations of point angle, lip relief angle and helix angle. The range of geometric angles gives every possible drill point that is practical for drilling metal, fiber, plastics, wood and other allied materials. Connecticut Special Machine, Inc. **(Circle 510)**

Cleaning, Plating, Painting

A catalog describes ultrasonic cleaning applications and equipment, explaining in detail the descriptions and features of tank transducers and generators for use in large and small-scale degreasing operations. Phillips Mfg. Co., Inc. **(Circle 511)**

Cutting Tools

A bulletin which describes and pictures standard and special carbide turning, milling and boring tools shows how companies can answer the question, "Should conventional or throwaways be used?" Wesson Co. **(Circle 512)** . . . A complete, permanent reference bulletin aids in ordering blades and tools for all types of centerless grinders and screw machines. Ohio Knife Co. **(Circle 513)**

Electric Motors, Controls, Drives

A fractional horsepower motor has a ventilation system that makes it up to 10 percent cooler than other comparably rated motors. Reliance Electric & Engrg. Co. **(Circle 514)**

Finishing, Grinding

Catalog entitled "Loungway Rise & Fall Abrasive Belt Grinder" gives examples of parts produced on this grinding machine, including items requiring intermittent ground surfaces, fillets and contours. Eastern Machine Screw Corp. **(Circle 515)** . . . Booklet covers considerations in the evaluation of vibratory finishers. Vibraslide, Inc. **(Circle 516)** . . . Five heavy-duty blast cleaning barrels have work capacities ranging from 15 to 102 cu ft. Pangborn Corp. **(Circle 517)** . . . A revised edition of "Barrel Finishing" includes descriptions of the various barrel finishing processes, recommendations of the various abrasive shapes and sizes for applications in which they are best suited, case histories of actual uses, description of all types of finishing equipment available, discussion on compounds and their effects and a section on practical suggestions for operating Fuel Engrg. Co. **(Circle 518)**

Fluid Power

Electrical-mechanical positioners can be used to automatically position many types of technical devices regulating machine tools, valves, floats, doors, saws, hoppers, throttles, etc., at any of several predetermined positions corresponding to a remote control selector switch signal. Hanna Engrg. Works. **(Circle 519)**

Heat-Treating

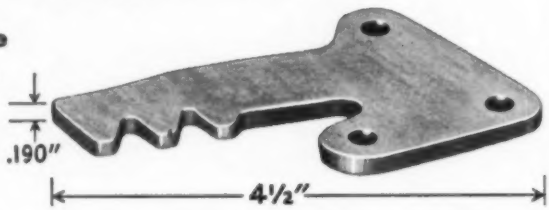
"Heat Treat Review" contains an article on safety standards for heat-treating equipment. Other articles cover a discussion of bell type coil annealing furnaces which use power convection and a case history of a commercial heat-treater who, unable to expand his plant because of land shortage, found a way to double his production. Surface Combustion Div., Midland-Ross Corp. **(Circle 520)** . . . Eight atmospheric gas-fired burners have maximum firing capacities from 10,000 to 2,750,000 Btu/hr. Eclipse Fuel Engrg Co. **(Circle 521)**

Inspection, Measurement

One section of a 60-page book on optical comparators gives a step-by-step illustrated demonstration of how basic measuring is accomplished. Jones & Lamson Machine Co. **(Circle 522)** . . . An idea book pictures many gage modifications

300,000 Blanks Stamped Between Regrinds . . .

"TRI-TUNG" Die Still Operating After 1,200,000 Stampings!



How would you like to stamp 300,000 parts like this, between regrinds? That's the kind of tool life reported by Ferro Stamping Co., Detroit, Mich., with Uddeholm's Fine Swedish Tool Steel.

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DESIGNED AND PRICED FOR MACHINE BUILDERS USE

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Trade Literature

of interest to inspection engineers. Boice Gages, Inc. **(Circle 523)** . . . "How To Measure and Relate Pipe, Tubing and Hose Sizes" supplies methods of measurements, discussing both the similarities and the differences involved in measuring various fittings and fluid carrying lines in order to arrive at satisfactory fluid line installations. Aeroquip Corp. **(Circle 524)** . . . New single frequency nondestructive inspection devices find flaws in nonferrous, nonmagnetic metals at production speeds of 50 to 600 fpm in materials with diameters as large as three inches and indicates them on an oscilloscope screen. Magnetic Analysis Corp. **(Circle 525)** . . . A catalog sheet describes a series of outside micrometer calipers in the 1 to 60-inch size range and includes information on construction materials used, lists part numbers on each instrument and offers data on optional features such as locknut, vernier, friction stop and friction thimble. J. T. Slocomb Co. **(Circle 526)** . . . Air gaging principles and applications as well as the equipment available for performing these functions are described in a book. Also covered are gages for production, inspection and quality control units incorporating air gaging techniques and an instrument that provides instantaneous checking of functional relationships such as center distance, taper angle and squareness of face to bore. Another section is devoted to air capsules, which permit incorporation of air gaging to standard instruments such as height gages as well as special fixtures. Wide tolerance gaging is also discussed. Taft-Peirce Mfg. Co. **(Circle 527)** . . . A 12-page bulletin describes a line of ultrasonic testing equipment, portable industrial X-ray and magnetic particle inspection equipment and supplies. Sperry Products Co. **(Circle 528)** . . . An automatic all-parameter check-out system capable of checking any characteristic convertible to an electrical equivalent is described and illustrated in a bulletin. Audiotronics Co. **(Circle 529)** . . . One of the instruments produced by Philips of the Netherlands can measure, record and analyze vibration and strain. A fully transistorized hand-held vibration meter measures amplitudes from zero to 1000 microns and has a sensitivity of zero to 10 microns. Other devices are an electrodynamic transducer which measures either absolute or relative vibrations and a magnetic transducer which requires no contact with the vibrating object. Korfund Co. **(Circle 530)** . . . Angles through 360 deg can be set and checked within a range of one second to

10 min and by estimation to 0.5 sec with the microptic clinometer and its accessories. Engis Equipment Co. **(Circle 531)**

Lathes

A catalog on ceramic cutting tools gives the properties and specifications of throwaway inserts, button inserts, solid inserts, unground blanks, single-point tools and toolholders. Carborundum Co. **(Circle 532)** . . . A bulletin called "Turn with Tape" describes lathes with headstocks and carriages designed to accept commands from a solid state numerical control system. R. K. LeBlond Machine Tool Co. **(Circle 533)** . . . Application ideas for single-spindle chucking automatics and information on workpieces, tooling, machine functions, setup and methods are presented in a 32-page booklet. Warner & Swasey Co. **(Circle 534)**

Lubricants

Twenty-six types of cutting fluids and lubricants are covered in a 52-page catalog. Physical and chemical properties, typical uses and descriptions of each are given in tabulated form. Shear-Speed Chemical Products Div., Michigan Tool Co. **(Circle 535)**

Materials

"Materials for Advanced Technology" describes materals which offer important opportunities for improved design and performance in applications requiring resistance to abrasion, chemicals, corrosion, nuclear radiation and high temperatures. Carborundum Co. **(Circle 536)** . . . Data in the form of comparative curves illustrates the high-temperature stress rupture properties of an air-melted, cobalt base alloy as compared to vacuum-melted, nickel base alloys. WaiMet Alloys Co. **(Circle 537)** . . . A booklet on silicones goes into detail about what silicones are and suggests ways in which they can be adapted to a host of applications by the design engineer or product development manager. Union Carbide Corp. **(Circle 538)** . . . Brand, producer, AISI number and the company's equivalent brand are revealed at a glance by the tool steel identifier. This slide rule guide also gives a complete AISI classification table listing chemical composition and designations for water hardening, shock resisting, cold work, hot work, high-speed and special purpose tool steels, Universal-Cyclops Steel Corp. **(Circle 539)** . . . A manual on machinable steel-bonded carbides is divided in four gen-

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AUTOMATIC FORCED LUBRICATION

- Continuous flow, recirculating system
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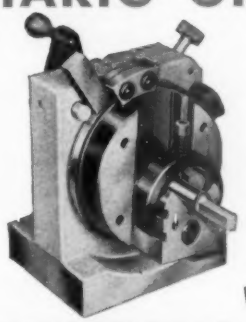
HARIG GRIND-ALL FIXTURE



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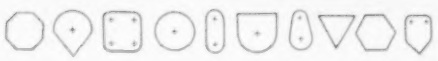

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eral sections: a description of machinable and hardenable carbides; typical tooling problems solved with this material; machining and heat-treating instructions; and physical properties. Sintercast Div., Chromalloy Corp. **(Circle 540)**... A data sheet describes a chromium alloy die steel that can be used for both hot and cold work applications but is especially adaptable for hot work performed by compression rather than by impact. Heppenstall Co. **(Circle 541)** . . . Three grades of ground stock are described in a binder. An oil-harding, manganese type tool steel is recommended for general applications. An air hardening steel is suggested for applications requiring high wear resistance and a low carbon steel is recommended for applications not requiring the abrasion resistance of tool steels. Vanadium-Alloys Steel Corp. **(Circle 542)** . . . Flat ways, V-ways, composite die sections, heel and guide blocks, and bronze wear plates—produced in quantity and carried in stock—can be used in dies, as die sections, flange sections, ways, gibs, rails and wear plates. Ohio Knife Co. **(Circle 543)** . . . A bimonthly publication presents techniques for the proper use of epoxy plastic materials in tooling and in master model and pattern making. Ren Plastics, Inc. **(Circle 544)** . . . A chart shows that chemical analysis requirements for the more widely used military, Army-Navy aeronautical and Federal alloy steels and lists specified forms (sheets, bars tubing, etc.) and the nearest SAE, AISI and AMS numbers. Peter A. Frasse & Co., Inc. **(Circle 545)** . . . A 20-page booklet describes a new plastic for injection molding. Naugatuck Chemical Div., United States Rubber Co. **(Circle 546)** . . . Ways to make high-impact or flexible as well as rigid castings from a transparent epoxy resin are outlined in a bulletin. Marblette Corp. **(Circle 547)** . . . A flame-retardant industrial thermosetting plastic, which has both electronic and electrical uses, is a paper-based laminated plastic bonded with a plasticized phenolic resin. Synthane Corp. **(Circle 548)**

Milling

A catalog describes and discusses a line of arbors and accessories. Cincinnati Milling Machine Co. **(Circle 549)** . . . A 44-page bulletin gives specifications on throwaway and conventional carbide milling cutters, accessories, blades, parts and tools. A throwaway insert and inserted-blade cutters are also covered. Wesson Co. **(Circle 550)** . . . General purpose straight facing mills and side mills, slotting cutters and fly cutters are described in a 24-page catalog. The catalog also covers accessories and includes sections on mounting details, care and maintenance and cost reduction. Futurmill, Inc. **(Circle 551)**

Pressworking

Five and 10-ton presses, both standard and deep-throat models, are available for bench or floor mounting and are designed to operate in either an upright or inclined position. Havir Mfg. Co. **(Circle 552)** . . . A new open-back inclinable punch press has a 30-ton capacity and a 15 percent overload safety factor. Whitney Metal Tool Co. **(Circle 553)**

Welding

A bulletin entitled "Arc Welding Stainless Steel" gives physical properties, structure and welding characteristics of various types of steel. Lincoln Electric Co. **(Circle 554)** . . . Four case histories are used in describing a method of automating production soldering and brazing operations with paste alloys. Fusion Engrg. **(Circle 555)**

The Pangborn Vibratory Finishing Machine

THE LONGER YOU OWN IT, THE MORE USEFUL IT IS!

"Every day we find new pieces it can finish," comes the word from the large, Midwestern die-casting firm shown above. And no wonder!

This machine makes itself useful in many ways: cleaning, descaling, radiusing, fine-finishing, burnishing or coloring. It can do all this with metals, alloys, many types of plastic and ceramic parts . . . and at speeds up to 100 times faster than conventional methods. It cleans the intricate or shielded surfaces you can't reach with barrel finishing or other means.

Available in many sizes, the Pangborn Vibratory Finishing Machine is the most compact unit in its field. Its standard equipment includes variable speeds and an exclusive air-cushioned suspension which assures automatic leveling and amplitude control. Auxiliary equipment, media and compounds available for every need.

Send parts with exact finish specifications or finished specimen, for sample processing in our laboratory to Mr. William E. Brandt, PANGBORN CORPORATION, 4700 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control, Blast Cleaning and Vibratory Finishing Equipment—Rotoblast® Steel Shot and Grit.*™

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.....readers' viewpoints

. . . european obsolescence

To ASTME:

While in Europe early last summer, I visited the Volkswagen Works in Wolfsburg, Germany, and was astonished with their tooling. Much was done the hard way—by hand and with hand tools. All over western Europe, including East Germany, I noted toolless manufacturing. There is nowhere a comparison with American production. Over there, they seem to enjoy the tradition of doing things the hard way and I can call none of them "pioneers."

In America we can have only one enemy—complacency. If we cannot test a shaper to ram-breaking capacity, a mill to full depth cutting and drills to ultrasonic speeds or cannot chemically machine or plastic form, we will relinquish world leadership. Unfortunately, since we cannot inquire into this possibility, we must proceed on the roast-pig basis—burning down the house to attain our objective—with the contemplation of war and the consequent sandbagging of taxpayers for money and authority to venture off the beaten path. We will not take backward steps; obsolescence will continue mechanically. . .

J. R. McWhorter
Chapter 84, Long Beach
Los Angeles, Calif.

. . . step drilling

To the Editor:

There are thousands of plain folk who are faced with the everyday simple sharpening drills.

My article entitled "Drilling Holes to Size" published in the Dec. 1960 issue was an effort to write on the simple aspects of the manufacturing technique. To date I have received some very favorable comments, one of which concerned half drills. We have done some research in that area and find that originally drills were half diameters and that many of the old-time toolmakers were well versed in the use of half-round drills.

We are still struggling with the problem of developing a drill somewhere between a twist drill and a gun drill. A ⅛-inch twist drill costs about $.50. A ⅛-inch, 6-inch-long gun drill costs from $50 to $80. Maybe within the next two years, we will be able to come up with some conclusions and recommendations.

Frank Zagar, President
Zagar, Inc.
Cleveland, Ohio

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Turret
TOOL POSTS

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9 SIZES

● Successive tools are swung into position **quickly**, indexed **accurately**, and locked **rigidly**, enabling engine lathes to handle a wide variety of work efficiently and economically. Ruggedly built. 12 indexing positions. Mount in the T-slot of the compound rest or bolt circle of the main slide. Unsurpassed for performance and satisfaction.

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COST CUTTING TOOLS
Engineering and Sales Representatives in the Principal Cities

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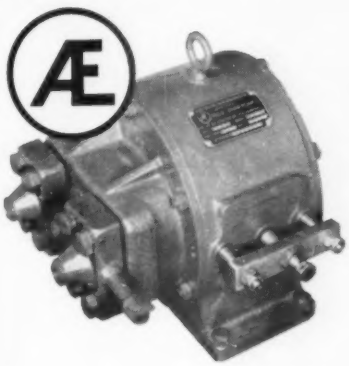
IMPORTANT NEWS
FOR HYDRAULIC PUMP USERS



AMERICAN ENGINEERING'S HELE-SHAW and **HYDRAMITE** pumps are now being precision engineered and fabricated at the Aircraft Armaments, Inc. plant at Cockeysville, Md.

Be assured that the same craftsmanship and high standards of quality which make **HELE-SHAW** and **HYDRAMITE** pumps leaders in their field will be maintained in the **IMMEDIATE CONTINUED PRODUCTION** of these pumps by Aircraft Armaments, Inc.

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AE INDUSTRIAL DIVISION
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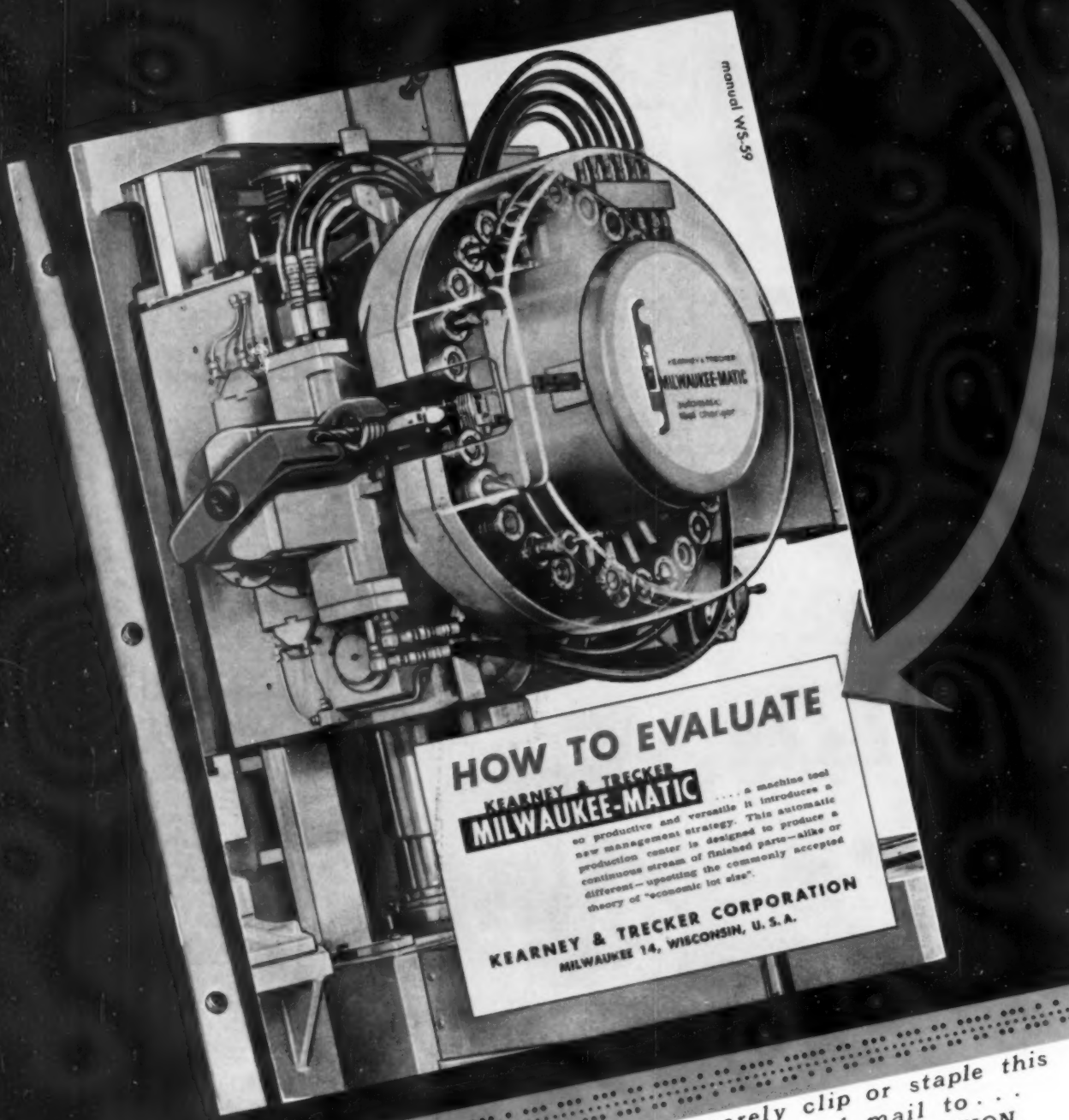
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KEARNEY & TRECKER
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. . . . a machine tool so productive and versatile it introduces a new management strategy. This automatic production center is designed to produce a continuous stream of finished parts—alike or different—upsetting the commonly accepted theory of "economic lot size".
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Tech Digests

Scientific Methods of Investigation

In the study of any subject, a variety of methods is available to the investigator. Results of scientific and engineering studies depend to a considerable extent on the method selected, and the manner in which it is employed. In this paper, the author describes a rigorous and exact method of scientific investigation, having broad application to scientific and engineering problems. The method employs the approach of defining the subject to be studied as a "system" and lays down a method for building a rigorous "model" of the system.

A system is any actual or potential complex of physical objects. The complex can be a natural one, as the solar system or an elephant; or it can be man-made, as an orchard or an automobile. A special system study is a study of such a system from a single point of view, for example, a study of the solar system from the point of view of the gravitational forces within it. A general system study, uses many different aspects or points of view. For example, an elephant can be studied from the point of view of anatomical structure, physiological functions, individual and group behavior, etc.

A special system study can be conceptualized and manipulated by means of a formal model, often a linguistic presentation of undefined terms and their interrelationships. The model's undefined terms refer to actual elements of the physical system whose interrelationships are analogous to the interrelationships between the terms of the model. An example of this is Euclidian geometry, used for surveying. System elements are defined logically prior to the relationships. This has in the past often led down a crooked road, as for example, with the Greek "elements."

In general system studies, this system usually cannot be conceptualized through formal models. An alternative method must be used for modeling these systems. The approach suggested in this paper begins modeling with a classification of system attributes. A simple listing of system attributes is of little use unless some order can be brought to bear upon it. One way is to classify them into three mutually exclusive classes—determiners, components, and integrators. Determiners affect the system from outside the system, include inputs which the system must accept, and other constraints external to the system which operate upon the system. Components make up the actual parts of the system. They are internal and integral to the system proper. The third group integrates the system components. These are the various time sequences in which operations or actions occur within the system, communications within the system, organization of the components and the decision structure, etc.

Once the elements have been listed and classified, the attributes can be subjected to various criteria to determine relationships. The criteria employed are analogous to those used in the construction of sets, subsets and the families of numbers. Since, in a general system study, the attributes are drawn from different disciplinary viewpoints, they tend to overlap. The attributes within each category must be restated so that the referents of the terms are independent of each. If the restatement of the attributes is achieved in all three categories, the attributes thus evolved can be considered to be the essential independent attributes of the system. This in effect reduces the different points of view to one self-consistent point of view, and the general system study has been reduced to a special system study. It thus becomes responsive to the exacting methods of basic scientific research.

From "A Methodology for Modeling in General System Studies," by K. H. Schaefer, Stanford Research Institute, Menlo Park, Calif. Presented at the 1960 International Congress for Logic, Methodology, and Philosophy of Science.

Program Exchange in Professional Societies

Specalization is the result of an information retrieval problem. There is too much knowledge to be stuffed into one person's head and hence people specialize and split into groups. The whole idea of computing machines is to handle a big body of routine knowledge so that people can think in general terms and become generalists again, not specialists.

In general, professional societies help in program exchanges in three major ways: one, the societies represent a device for focusing technical leadership; two, the service of the societies relates to the economics of group effort. The volunteer efforts of single individuals and single organizations become far more effective when they work within the formal framework of a professional society. Three, societies publish data concerning advanced technology.

In view of the importance attached to increased communication, it should be noted that many of the people in the computing field do not take the time to develop and write up carefully what they have done. This results in deteriorated communication and obstacles to understanding.

The computer has come crashing into American industry in such a well-developed state that the assumption has been made that a new profession must be created to make effective use of it. It is more likely that the responsibility for coping with this is falling on the professions that already exist. In general, eight avenues of action exist for professional societies to improve computer utilization. They are: one, abstract service; two, publication of articles; three, publication, plus flow chart documentation; four, program manuals; five, program manuals plus

machine codes; six, edited program manuals; seven, program manuals plus codes produced by a technical staff; and eight, translation service.

In efforts to date, this is proving to be a good system. The facts show that many companies are duplicating each other's efforts, all at high expense. But a thoroughly debugged, independently approved engineering effort can be purchased for a modest price. Companies whose managements are close enough to realities of computer applications realize the need for organized interchange of technical results. The major method open to a professional society is to provide channels of communication between members for dissemination of technology and its applications that will expedite the economic use of improved information processing systems.

From "The Role of a Professional Society in Program Exchange," by W. M. Carlson, E. I. du Pont de Nemours & Co., Wilmington, Del. Presented at the 1960 Computer Applications Symposium, sponsored by the Armour Research Foundation, Illinois Institute of Technology, Chicago 16, Ill.

Changes Facing Management

Industries on which this country grew to greatness remain important but are now being paralleled by new strategic lines of enterprise vastly different in their needs for materials, technical processes, manpower and investment. We are on the doorstep of nuclear force and invention. We are just beginning the vault into the ether of missiles and spacemen. Exciting chemistries and physics have the raw materials and finished products of tomorrow in the laboratory stages right now. Technology has overtaken every industry and agricultural pursuit as better and less costly products and production are demanded by enterprises as their means of survival.

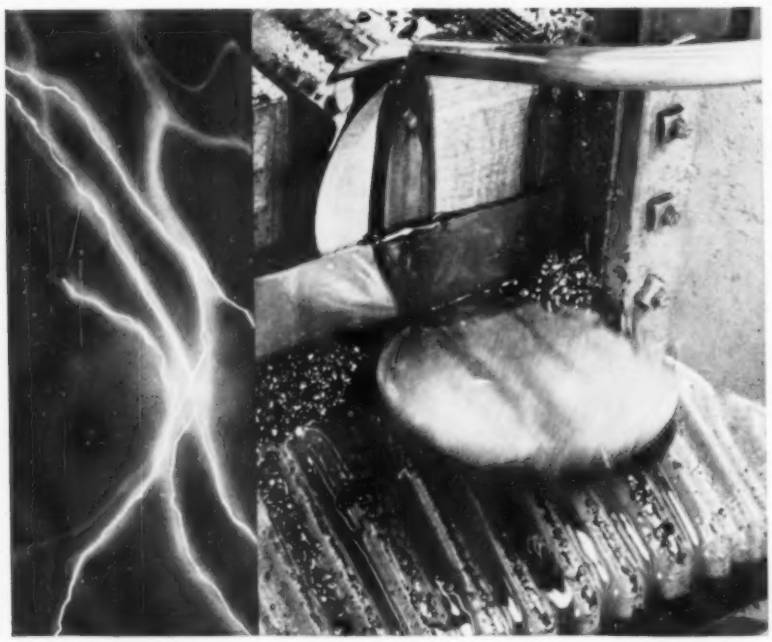
Some of this technical revolution, the replacement of men by machines and motors, we term automation. It is going ahead in every field by leaps and bounds. We have, in general, been walking ahead with progress in a dignified manner, and have grown used to it. Science is now pushing us along at a running pace, from which there is no escape.

To date, the greatest change in the national economy is the rise in the service industries, which are all those not classed as production industries. They now account for the highest percentage of our gross national product. The department of labor has discovered that production employees in the United States are stabilizing at 26 millions, and have, for the first time, dropped behind the employees in service industries, now totalling over 32 millions. Production, the foundation of American industry and enterprise, for the first time in the history of our country, has taken second place to the majority engaged in service industry operations.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Not only that, today's American employee is very different psychologically from former workers. He is better educated and better informed. With this upgrading, it is not surprising that today's worker is a more independent person. He is capable of more thinking for himself and more willing to move from job to job. The only restraint on his moving is the matter of company benefits that are accrued through seniority and I am convinced that it is only a matter of time until that barrier will be changed and company benefits will follow the person rather than the job. The worker today is more susceptible to ambitions about his standard of living.

It is entirely possible that industry as a whole has not quite fully realized the evolutionary effects of these changes in work character or the challenge they impose on all management. But management is going to have to reach out further for the employee's interest, not only in their own fortunes but in the affairs of the enterprises of which they



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Your hack sawing machines will produce faster cutting-off on all types of work when they are equipped with unbreakable Marvel High-Speed-Edge Hack Saw Blades.

Why? Because these are the blades specifically designed to take the high speeds and heavier feed pressures demanded by today's production schedules.

What's more, your operators know—or will soon learn—they can increase speed and pressure without endangering themselves or the machine, because these are unbreakable Marvel High-Speed-Edge Blades . . . the blades that have set the standard for all other blades to match—if they can.

Ask for Marvel High-Speed-Edge Hack Saw Blades by name and you can be sure you're getting the unbreakable blades designed to give you maximum accuracy and speed in your cutting-off operations. Leading Industrial Distributors have Marvel Blades in stock.

Write for the latest Cutting Tool Bulletin and the name of your nearest Marvel Distributor.

MARVEL Metal Cutting SAWS BETTER MACHINES BETTER BLADES

ARMSTRONG-BLUM MANUFACTURING CO. • 5700 Bloomingdale Avenue • Chicago 39, Illinois

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are part. Substantial changes are due to occur in the composition of the work force—there will be many more young workers, those under 25 will total nearly half the work force by 1970. Despite the earlier retirements, workers over 45 will steadily increase. It is estimated that the increase in employed women will be nearly twice as rapid as for male employees until by 1970 one out of every three employees will be a female. There are now approximately 73 million employees in this country. By 1970 it is estimated that the total will reach 87 million, of which 29 million will grow up into jobs in the next decade.

If today we do not fully know how to command the total productive interests of 73 million employees, the size of the challenge ahead of us is evident. Management, dealing with a larger element of younger persons, will not only have to learn better supervision, expect larger turnover, and install better training on the job, but it must find the key to worker interests over and above the financial incentive.

Practically everybody working is capable of achievement. It is with this that all business must learn how to deal as never before. Only in this can industrial management, beset with the needs for finer processes and more technical knowhow, obtain and control the productivity that will be demanded of it in the decade of the sixties.

From "Managing Men in the New Economy," by James J. Nance, president, Central National Bank, Cleveland, Ohio. Presented at the Executives Night Dinner Meeting of the Cleveland Section of the American Welding Society, 33 W. 39th St., New York 18, N. Y.

Computer Controlled Annealing

The continuous annealing process is theoretically a simple operation. In actual practice, however, this process becomes complex for the following reasons:

1. Grain growth occurs at a temperature between 1100 and 1330 F
2. No means exists for accurately measuring temperature of a moving strip inside of a sealed furnace
3. Zone temperatures cannot be changed rapidly in the furnace
4. Response to annealing varies with strip composition
5. Incoming strip varies in dimensions
6. Time variations affect temperature
7. Heat absorbing capacity of the strip affects temperature
8. Finish coils are sheared at an entry weld.

MAJOR AIRCRAFT MANUFACTURER MAKES . . .

Fully Automatic Savings with NELCO TOOLS on Tape Controlled Miller!

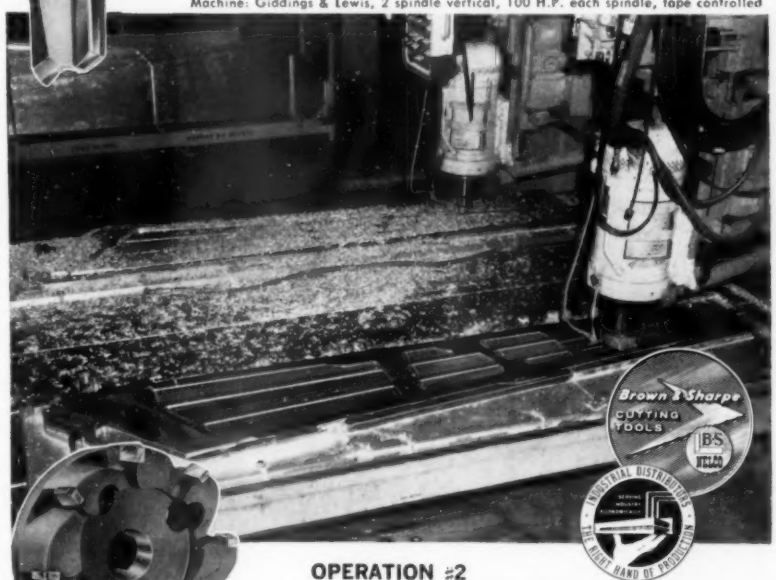
PROFILE MILLING AROUND WING SECTION

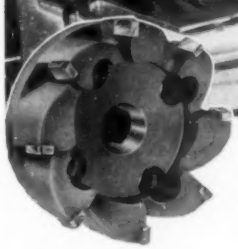
OPERATION #1

MATERIAL	Aluminum Alloy, Tough & Abrasive.
CUTTER USED	2" diameter, 2 flute NELCO Carbide Tipped End Mill. Negative Helix.
SPEED	3600 R.P.M., 1900 S.F.M.
FEED	20" per minute.
WIDTH OF CUT	1½".
DEPTH OF CUT	3/16 to 3/8 inch.
PRODUCTION	Nelco End Mill conformed to aircraft tolerances and to rugged automated production schedule.

There are 121 Nelco End Mills specially engineered to mill Aluminum.

Machine: Giddings & Lewis, 2 spindle vertical, 100 H.P. each spindle, tape controlled





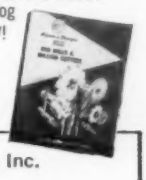
FACE MILLING WING SECTION

OPERATION #2

MATERIAL	Aluminum Alloy, Tough and Abrasive.
CUTTER USED	Standard 6" diameter Nelco Face Mill modified with 30° chamfer.
SPEED	3600 R.P.M., 5400 S.F.M.
FEED	80" per minute
WIDTH OF CUT	6"
DEPTH OF CUT	¼ to ⅜ inch.
PRODUCTION	2 cubic feet of metal removed in 20 minutes. 6 pieces per grind—12 cubic feet of metal removed per grind.

Again, NELCO Carbide Tipped Tools prove their economy and dependability. NELCO manufactures the most complete line of Carbide Cutting Tools engineered to mill ALUMINUM. They are available through your Local Distributor.

Send for the NELCO Catalog today!



For that EXTRA Edge in Production!

NELCO

NELCO Tool Co., Inc.
Subsidiary of:
Cutting Tool Division
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Providence 1, Rhode Island

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Jones & Laughlin decided to investigate computer control. A study of existing lines indicated that a digital computer, properly designed and applied, could raise annealing line operation from an art to a science.

The system was designed to accomplish three major functions: one, process control; two, data acquisition and logging; and three, production analysis and accounting.

A block diagram is provided and the system is described in detail. Fourteen different categories of information are obtained on punched cards. The computer control system is a production tool, and like other production machines, must justify its costs by providing an adequate return on investment. It is expected that the equipment will prove to be economical for several reasons. Scientific analysis and decision is substituted for human judgment. Scrap and reject is reduced by improving transition from one annealing practice to another. Costs are reduced by providing accounting records automatically. Furnace downtime is reduced. Operating data is available to make operating decisions. Long range benefits include increased process knowledge that will in time permit better design of annealing lines.

From "Control Computer System for a Continuous Annealing Line," by J. T. Bradford Jones & Laughlin Steel Corp., Pittsburgh, Pa. and R. W. Kirkland, General Electric Co., Schenectady, N. Y. Presented at the AIEE-AICHE-IRE-ISA-ASME Joint Automatic Control Conference, Cambridge, Mass. Sponsored by the American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

New ARMSTRONG Swivel Pad can't come off

Now ARMSTRONG deep throat "C" Clamps have the new (Pat. apd. for) ARMSTRONG Ball-joint Swivel Pad. This "C" Clamp pad, developed by ARMSTRONG Engineers, is tougher than any on the market. Rigorous testing in our own plant first proved this fact, and field tests in factories throughout the country have confirmed our own test results.

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The lip of the opening in the ARMSTRONG Ball-joint Swivel Pad is undercut so that when the ball of the screw is inserted, and the lip is permanently forced down, a solid steel wall is formed, inside the pad cavity, completely encircling the ball.

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Case Studies in Preventive Maintenance

Annual savings of around $30,000 were achieved by examining the preventive maintenance operation of a large General Electric plant. The plant was an old established one. Operations were considered sound over the years and were performed by men with recognized skill. Maintenance expenditures had deviated very little over the years. The ratio of sales billed to first cost of plant and equipment had remained stable. Machine time downtime did not cause any undue trouble.

Despite this fairly satisfactory record, a preventive maintenance plan was set up. Its objective was to decrease maintenance cost by minimizing machine downtime, increasing the efficiency of the maintenance staff and taking better care of the equipment.

The plan is indicated in outline form and the methods of implementation discussed in detail. Cost savings achieved to date have been gratifying. Further reduction in maintenance cost is anticipated.

From "Case Reports in Preventive Maintenance," by Charles A. Fenton, Supervisor, General Electric Co., Schenectady, N. Y. Presented at the 12th Plant Maintenance & Engineering Conference, Chicago, Ill.

Maintenance Welding

Since maintenance welding requirements are so broad, choice of filler metals becomes an acute and perplexing problem. When the analysis of the base metal to be welded is unknown (as is often the case) an already difficult situation becomes more difficult. If a breakdown occurs that interrupts production, mounting overhead adds more pressure. And the repair may have to be made in an inaccessible location where both reach and sight are limited. That so much good maintenance welding is accomplished is a tribute to the ability of maintenance engineers and welders.

Four principle situations call for maintenance welding: fracture, wear, corrosion, and new construction (including modifications of existing equipment.) Some generalizations are needed to select appropriate filler materials to meet the various conditions encountered. While most of the metals in the periodic system will be encountered by the maintenance staff, this study of the filler metals is restricted to constructional steels, cast irons, stainless steels, and wear resistant materials. Tables and references are provided, and many examples discussed.

From "Filler Materials for Maintenance Welding," by Orville T. Barnett, Assistant Director, Armour Research Foundation, Illinois Institute of Technology, Chicago 16, Ill. Presented at the 12th Plant Maintenance & Engineering Conference, Chicago, Ill.

Scale Models

Engineers live and move in a three-dimensional world, yet resort to two-dimensional presentation of much of their brain work. Two-dimensional representations result in translation losses such as errors in transmitting design information, delays in planning, difficulty in evaluation of alternates, and loss of management time. Translation losses add to the final, over-all price of the job. To eliminate such losses as much as possible, a deliberate effort was made to develop models for engineering. Sufficient equipment for the model shop cost $542.61. Training cost $930. Results of experience to date, indicate that care must be exercised in the choice of projects to be modeled. Factors defining the need for models are, complexity of the system, concentration of equipment in an area, engineering problems that can be solved by building the model, and the need for clear presentation to management. Result is a practical engineering tool whose gains exceed its cost.

From ASME Paper No. 60-WA-267 "Developing the Scale Model for Factory Construction and Maintenance" by M. T. Cutrell, Construction Engineer, Proctor and Gamble Manufacturing Co., Dallas, Texas. Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

Insuring Cleanliness

During the past two or three years much has been spoken and written about "white rooms." These rooms have been variously called clean rooms, ultraclean, superclean, environmentally controlled, dust controlled, dust free, and so forth. The name "dust free" is a misnomer, there is no such thing. The subject of clean rooms is covered in five major categories. These are, one, type of facility required; two, general design features; three, housekeeping standards; four, employee training; and five, rules and regulations.

Deletions or additions to the list of facility requirements can drastically affect initial costs or costs involved in later changes. Prices vary in direct proportion to the number of items included in the original design and construction. The price range of $28. to $50. per sq. ft. does not include equipment. The facility at Kearfott Div., costing $46. per sq ft. is discussed at length. A list of 28 rules and regulations is included to provide guidance in setting up a clean environment room.

From "Insuring Cleanliness in the White Room," by C. E. Schmid, Kearfott Div., General Precision, Inc. Presented at the 12th Plant Maintenance & Engineering Conference, Chicago, Ill.

Statistical Data Reduction

Quality control in automated production, continuous processes of the chemical industry and large scale experimentation require highly efficient data processing schemes. In many cases, Gaussian distributions of individual readings lend themselves to statistical data reduction.

Special hybrid computers use composite analog digital techniques for real time data reduction in conjunction with conventional stored program digital systems. The latter serves as communication link to produce concise reports or to perform control functions in feedback systems.

The great advantages of statistical concepts yield highly effective reduction of the volume of raw information at the system input. Discrimination between drifting mean values or deteriorating standard deviations permits direct adjustments of settings or necessary changes of the transfer functions, respectively.

From *Technical Memorandum* No. 1, "Statistical Data Reduction and Control Systems," by Dr. E. J. Schubert, Technical Director, Monitor Systems Inc., Fort Washington, Pa.

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leading machine tool manufacturer, after comparing several types of equipment, installed a MILBAND cut-off machine. One of the operations involves cut-off of 9¾" lengths from A4150 hot rolled steel, 4½" diam., hardness Bhn 230, with MILBAND speed at 170 fpm and No. 3 feed setting. Plant location: New Philadelphia, Ohio.
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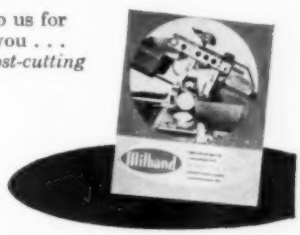

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Repair Welding

Although there is seldom any hesitation in utilizing a welding process in salvaging rough castings or machined parts in which no critical dimensons are involved, the problems of distortion which accompany any welding operation have frequently discouraged the application of welding to the fabrication or repair of finished machined products in which dimensional tolerances must be held. Yet, by combining some of the newer techniques with caution and ingenuity, we can now obtain results that would have been considered impossible a short time ago.

The forces tending to cause distortion are present in every weld made. Unless proper procedures and techniques are used, equipment or machinery subjected to welding operations may possibly distort to a point where an excessive amount of time and money must be spent in corrective action.

Distortion can be controlled during a welding process, but such control requires full consideration of all forces of expansion and contraction which will result from the heat of the weld. However, it is not sufficient merely to make a prior calculation of the amount of distortion which will apparently take place and then proceed with the job without planned control procedures and techniques. Measurement and control must accompany every phase of the job.

Examples of a fabricating method and repair jobs illustrate certain techniques that we have found effective. The first case involves an electrically heated hot plate that is used to maintain the preheat temperature during fabrication of diaphragms for steam turbines. They are made in halves and are constructed by welding the vanes to the periphery of inner web and then welding an outer hand to the periphery of the vanes.

It is necessary to have the physical characteristics of the weld deposit as near as possible to those of the adjacent parts. To obtain welds of this class, extensive tests were made to determine the proper preheat temperature to be used in welding. The results of the tests indicated that a preheat of 600 F ±25 deg before welding and that the preheat must be held during the entire welding cycle and until the welded diaphragm had been placed in a preheated furnace for stress relief. A sixty-inch hot plate was designed and put into operation. It proved satisfactory and two more were built at a later date, one a duplicate of the first and the second a thirty-six inch.

Before starting any welding operations, the hot plate is covered with asbestos blankets and heated very slowly, with current from generators, to a temperature of 625 F. When the hot plate and the weldment are both at the proper temperature, the weldment is transferred to the hot plate, anchored securely and the entire weldment and top of hot plate covered with several layers of asbestos blankets.

The operator uncovers only enough of the area to be welded as is necessary; this holds the preheat and helps reduce ambient temperature. Operators can work almost continually without any noticeable discomfort. When operators change shifts, it is only necessary to cover the work with asbestos blankets and leave it because the temperature controls will keep it at the required temperature indefinitely.

The hot plate was operated continuously. Several hundred diaphragms were made before the job was completed. The hot plate is now being used to replace a gas hot plate on all types of work which requires that the preheat be held during the welding cycle. The results show that the class of weldment obtained by use of the electric hot plate is of much higher quality. Also, initial equipment and installation costs were about 25 percent lower than those for a gas hot plate of comparable size. For these reasons; better weldment quality, more desirable working environment and lower cost of the equipment, the electric hot plate has more than satisfied our requirements for this job and deserves serious consideration for other similar fabrications.

All the diaphragms made as stated herein were subjected to 100 percent x-ray inspection. Over 200 halves were made and in the lot, only one crack was found.

Another interesting job involved the welding of finished machined compressor casings in which we made use of holding bolts and braces, combined with skip-welding and back-stepping to control distortion. A period of almost four months was consumed for the repair. An approximate estimate indicated that the total cost of repair of all five casings was about equivalent to the cost of a single lower-half casing.

The third example is a job on a steam turbine spindle which employed control welding combined with the use of preheat and rotation to prevent distortion.

From a paper "Recent Experiences With Unusual Maintenance Welding Jobs" by Willard A. Schumbacker, Allis-Chalmers Mfg. Co., Milwaukee, Wis. Presented at the 12th Plant Maintenance & Engineering Show, Chicago, Ill.

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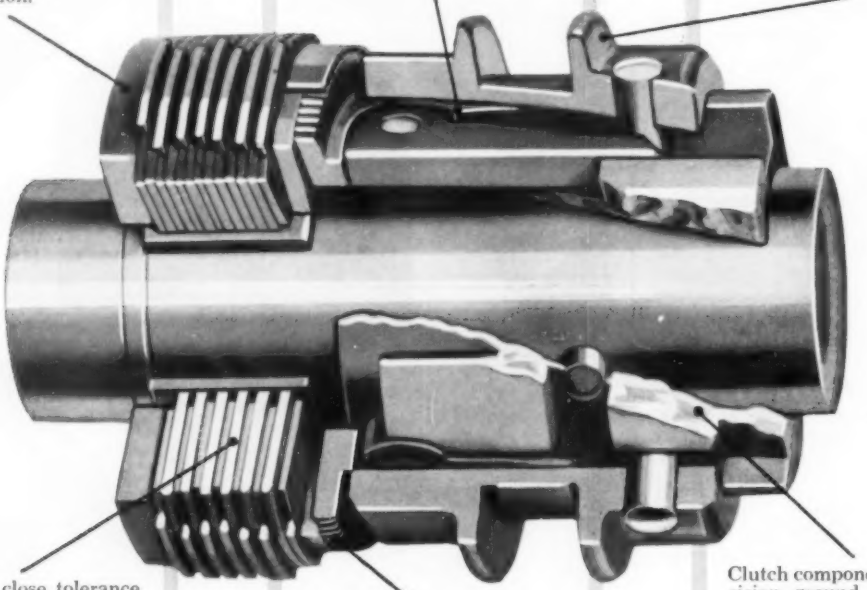

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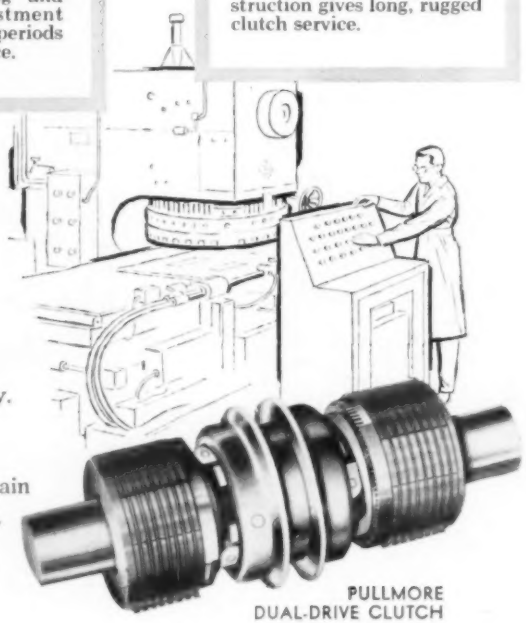

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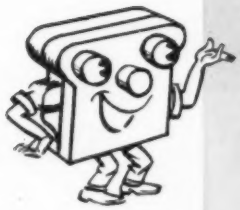

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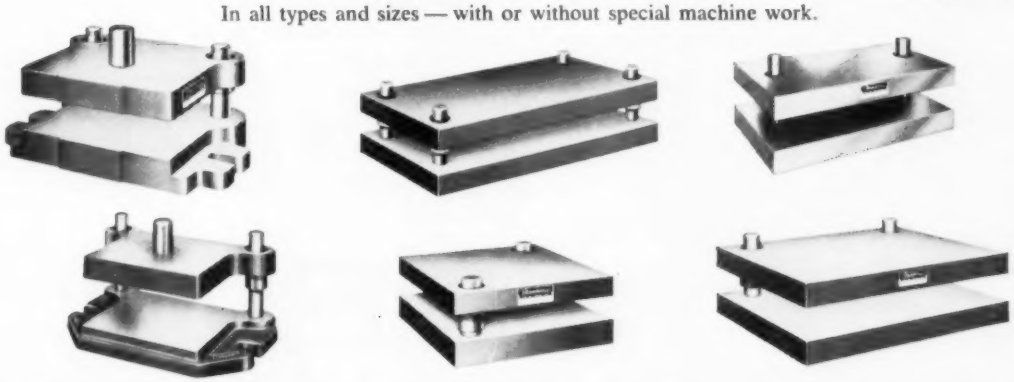

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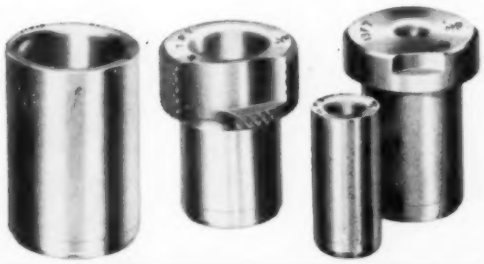

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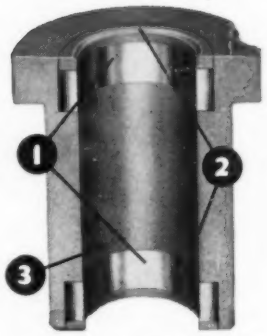

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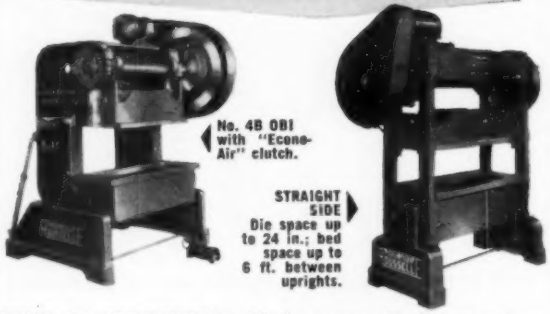

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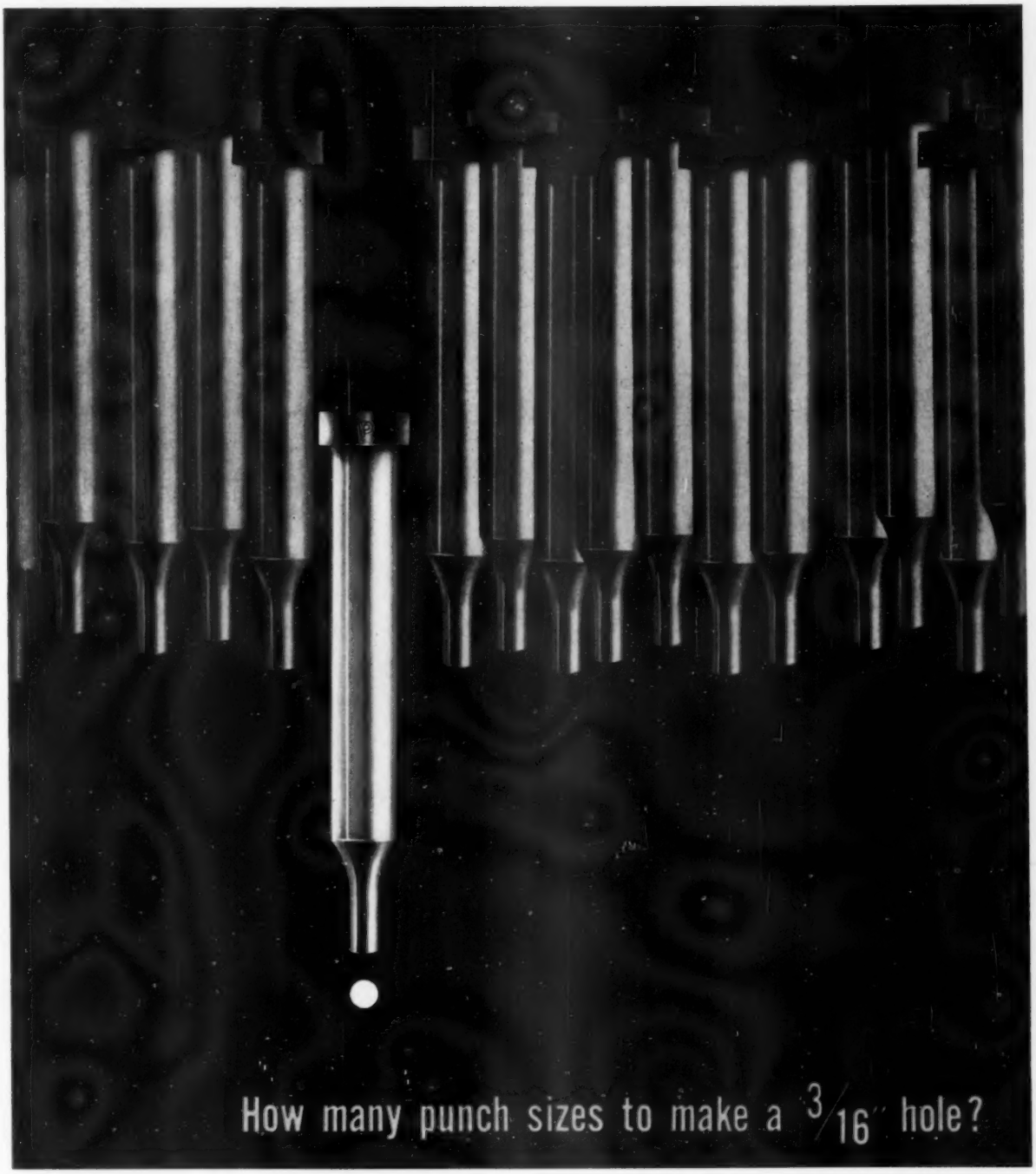

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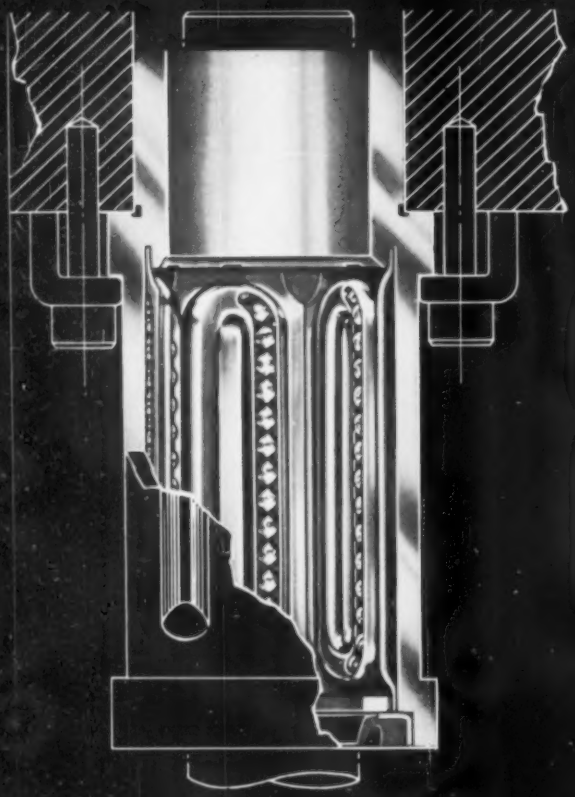

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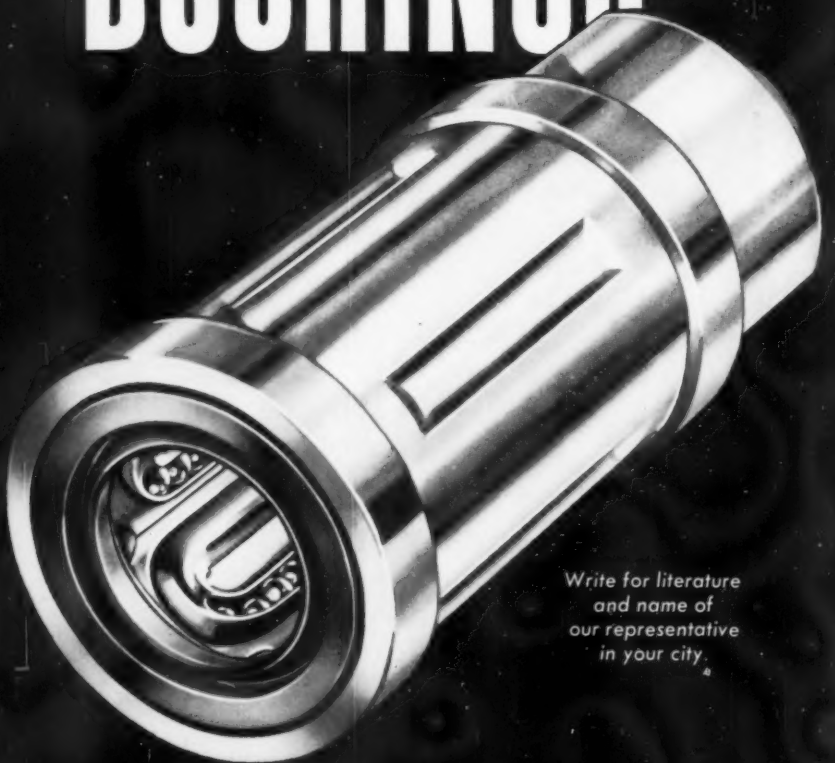

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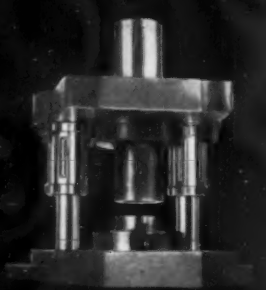

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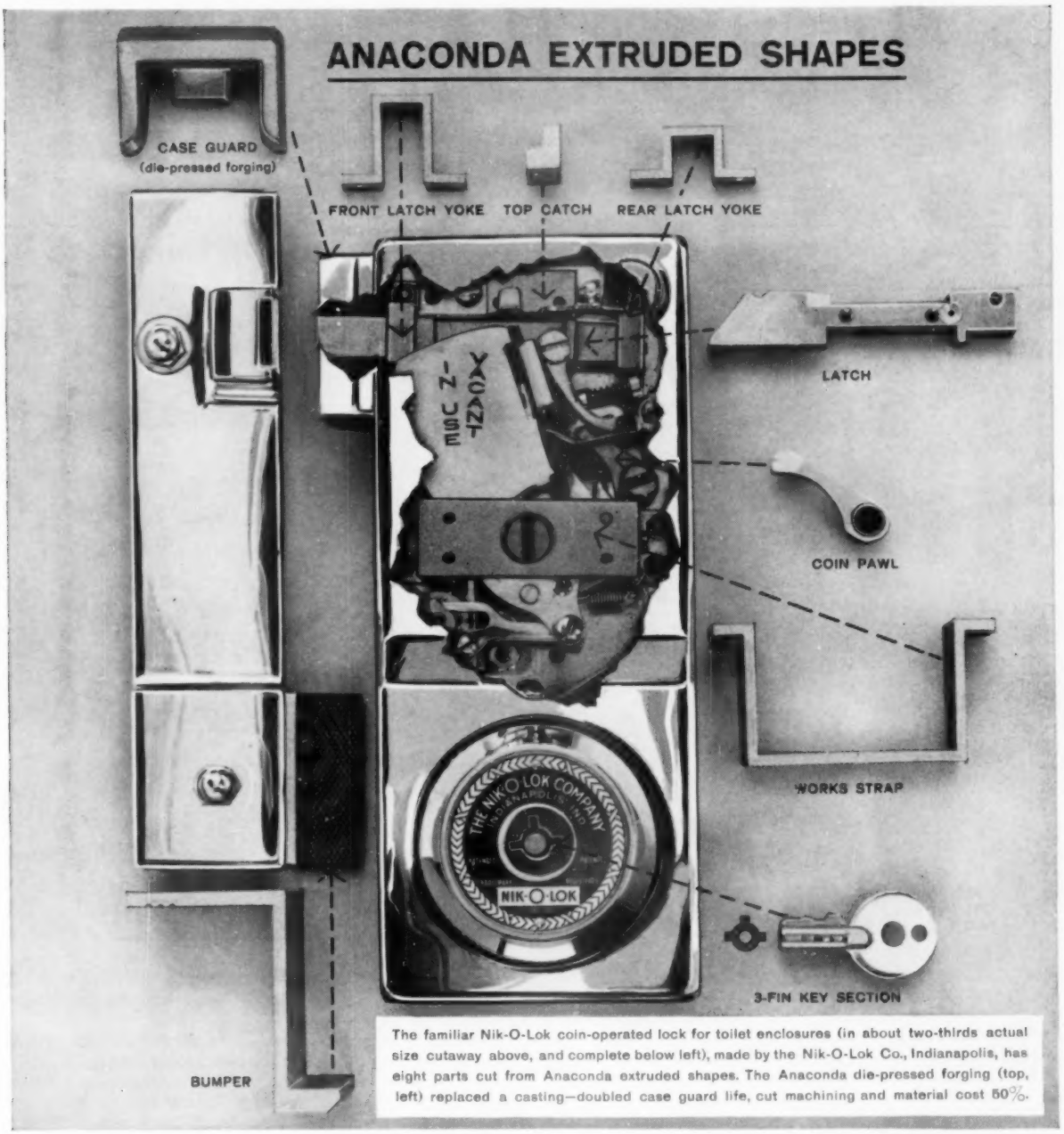

The familiar Nik-O-Lok coin-operated lock for toilet enclosures (in about two-thirds actual size cutaway above, and complete below left), made by the Nik-O-Lok Co., Indianapolis, has eight parts cut from Anaconda extruded shapes. The Anaconda die-pressed forging (top, left) replaced a casting—doubled case guard life, cut machining and material cost 50%.

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Now you can accurately select the proper tool steel based on its individual characteristics and be sure that it's available for off-the-shelf delivery before you place your order.

The new Allegheny Ludlum STEELECTOR Program makes tool steel selection fast. And it eliminates the embarrassment of specifying a grade which later turns out to be unavailable or available only after a costly delay.

The leading grades of tool steel that meet 96 percent of all applications—as listed in the Allegheny Ludlum Tool Steel Handbook—form the basis of the STEELECTOR Program. The STEELECTOR Grades are charted on cards covering each group of steels (tool room, hot work, and high speed grades) to help you select the particular grade best for your application.

Bar graphs on each STEELECTOR Card show how the various grades compare in abrasion resistance, toughness, size stability, machinability and red hardness. It's easy to determine accurately the combination of properties that best suits the job at hand.

The complete necessary range of sizes and shapes is listed in a special Data Stock List for every grade. These lists also include heat treating, typical working hardnesses and other data to insure that your selection is correct.

You can choose with confidence because every STEELECTOR grade has been selected from the complete line of Allegheny Ludlum Tool Steel and made under the rigid quality control standards of all A-L products.

For a complete explanation of the STEELECTOR Program, ask your Allegheny Ludlum sales representative for a copy of the colorful A-L Tool Steel STEELECTOR Booklet, or write: *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. TE-4-2.*

STEELECTOR PROGRAM

ALLEGHENY LUDLUM

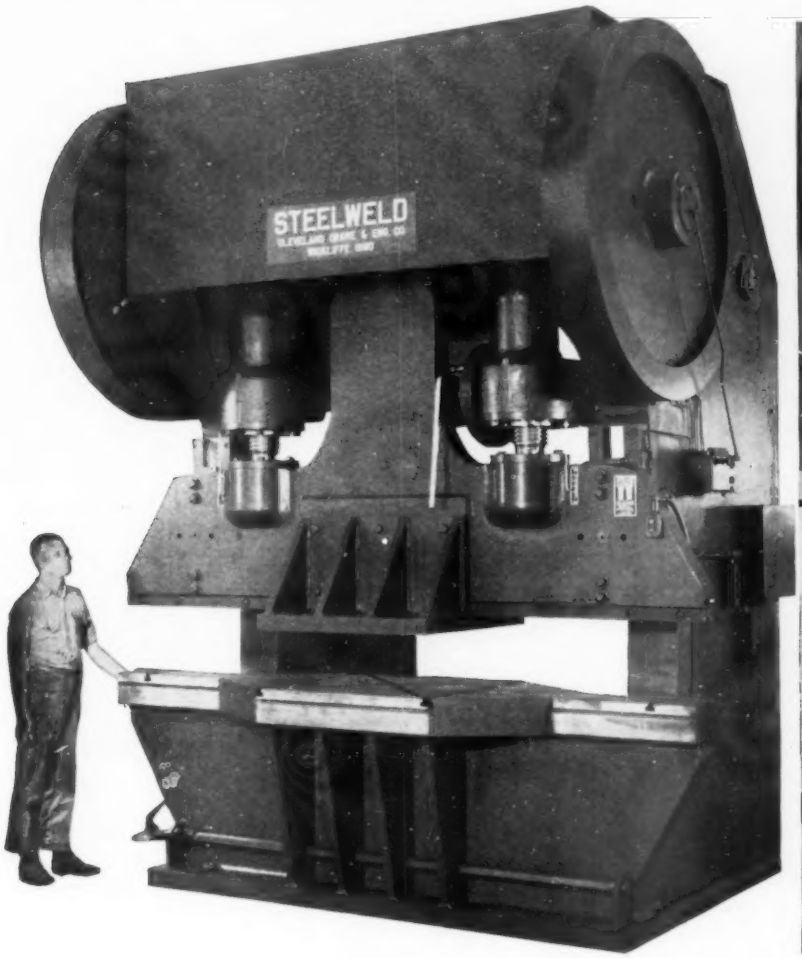
Tool Steel warehouse stocks throughout the country

2083

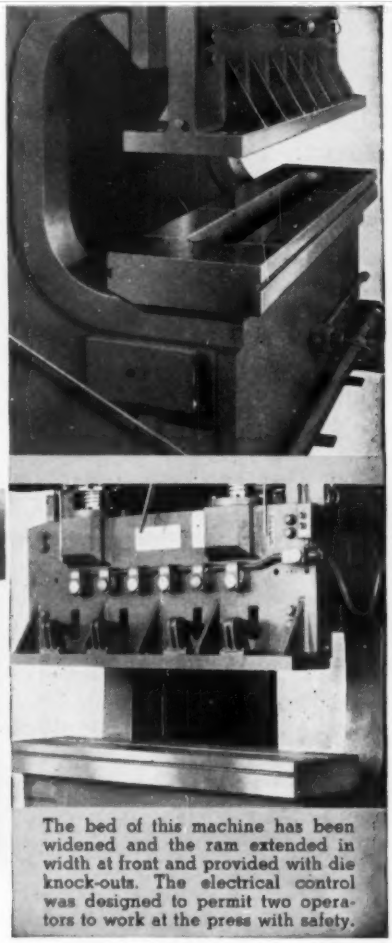
STEELWELD BRAKE DESIGN

Easily Adaptable For Special Requirements

Widening the bed of this 400 ton brake made it possible to serve a special purpose. The corresponding area of the ram was provided with a detachable ram bolster. With the bolster removed, normal brake operations can be carried on.



This Steelweld Brake was built with a double-plate bed having wide top and slot for punching purposes. This makes a low-cost press that is excellent within certain limits.



The bed of this machine has been widened and the ram extended in width at front and provided with die knock-outs. The electrical control was designed to permit two operators to work at the press with safety.

WHILE a standard press brake can handle a wide variety of metal-forming operations, often certain construction changes can be made that will permit doing work that normally would require a large costly forming press. Design changes can also be made that will speed production, improve safety or bring about other desirable advantages for specific types of work.

STEELWELD

PRESS BRAKES

Steelweld engineers have had a great deal of experience in tailoring press brakes to suit special jobs. Brakes have been built with many types of beds, with various shut heights, different speeds, unusual control arrangements, special gauges and safety devices, unique feeding equipment, etc. Because Steelweld's design is such as to make changes comparatively easy, the cost is reasonable.

For that next metal-forming job, whether it be a standard press brake operation or an out-of-the-ordinary one, it will pay you to investigate the possibilities of versatile Steelweld Press Brakes.

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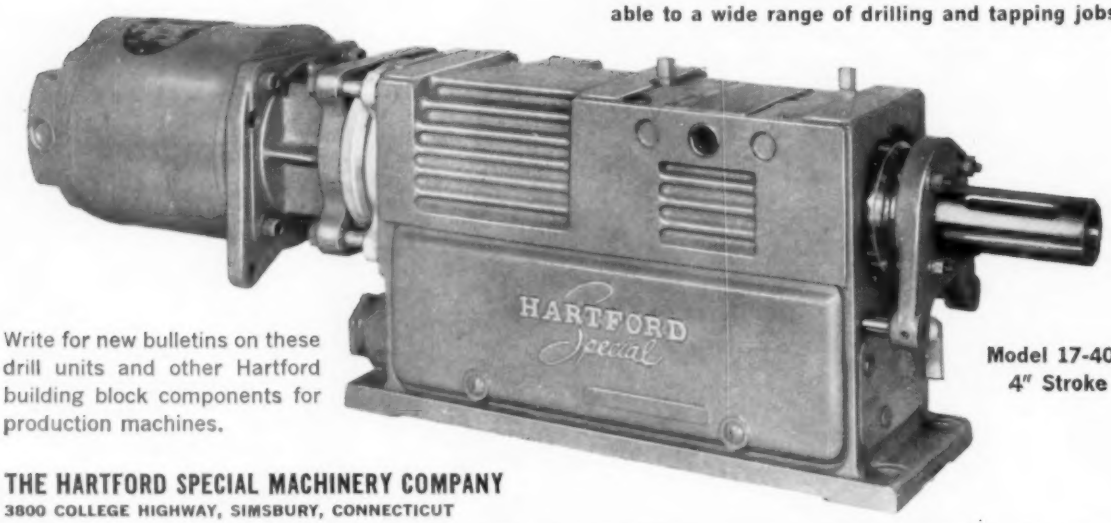
Easy adjustment of feed rate and stroke length makes Hartford air-hydraulic units quickly adaptable to a wide range of drilling and tapping jobs.



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Model 17-400
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Manufacturers of Precision Cutting Tools

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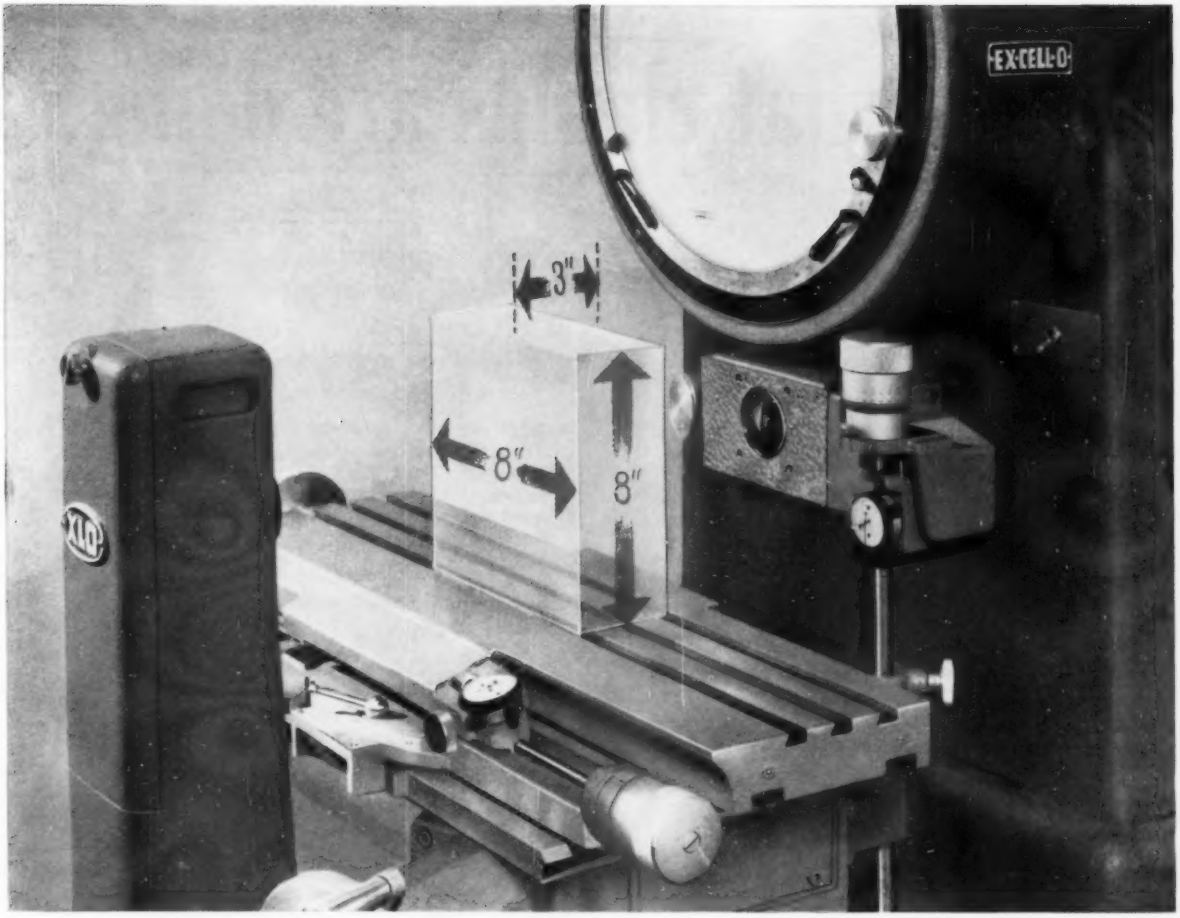

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Ex-Cell-O Models 14-5 and 30 give you capacity to accept and optically gage much larger parts than is possible with other contour projectors,—*and without repositioning on the table!*

A full 8″ of table travel in both horizontal and vertical planes, together with 3″ of focusing travel is standard on these Ex-Cell-O Models. Every point within this "block" can easily be brought into focus on the screen.

Here is real capacity,—192 cubic inches,—98% *more* than the nearest standard model! Enables users to stage shafts 16″ in diameter, (and larger in some cases), and 16½″ in length on the standard work table with standard centers. Any point along the part contour can be optically gaged with convenient table movement.

"Cubage" isn't the only Ex-Cell-O capacity Plus! You get constant 8″ of working distance (lens to focal plane) —20% more than other standard projectors. Full 8″ of vertical measuring travel. Constant throat clearance, (collimator lens to front projection lens), of 17½″ on the Model 14-5; 16″ on the Model 30;—and Ex-Cell-O's rugged, heavy duty tables enable you to stage parts weighing up to several hundred pounds.

When you are ready to talk about Contour Projectors, compare feature for feature! There is an OGP Representative near you to demonstrate Ex-Cell-O's many PLUS values. Call or write. In the meantime, let us send you "43 Reasons Why EX-CELL-O Contour Projectors are the First Choice of Industry."

You Can Purchase Ex-Cell-O Contour Projectors on Conventional Terms . . . Deferred Payment Plan . . . or Lease With or Without Purchase Option. Select the Plan Best Suited to Your Needs.

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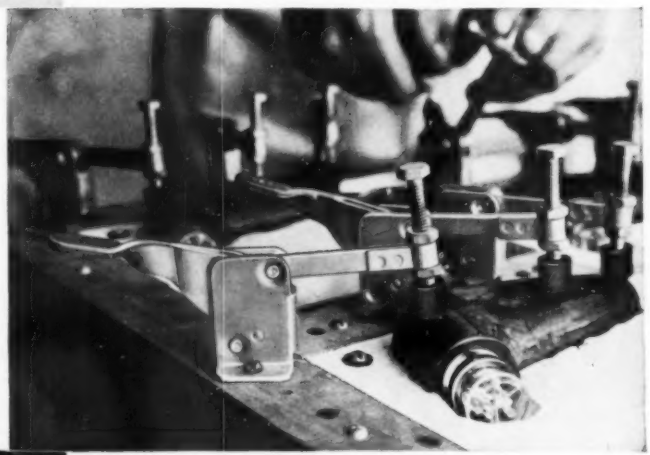
Look what clamps are doing!

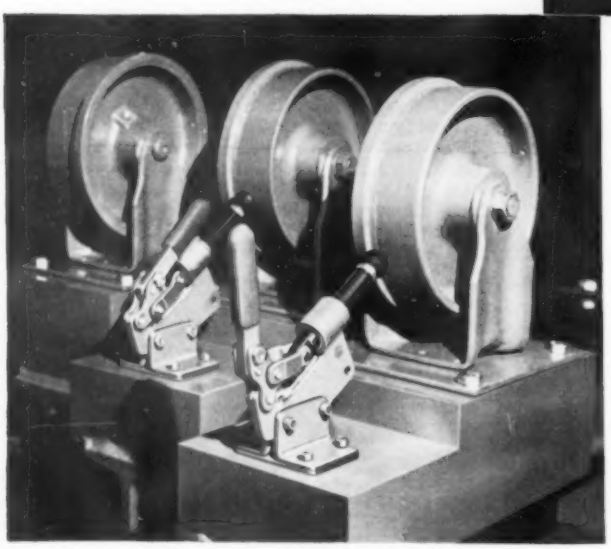
Practical uses of Wespo Toggle Clamps and Pliers that may suggest ways you can save

Toggle plier serves as low cost fixture for testing castings The air line is connected through one jaw of a Wespo Model 522 Toggle Plier. The plier is then clamped onto the casting and air applied by a foot control. Immersing the casting into a tank quickly spots any defects. Patented "Quick trigger" feature of the Model 522 instantly releases the casting; speeds testing. Rugged, lightweight Wespo toggle pliers are available in various jaw capacities and sizes.

Holding these glued parts together while drying is a simple task with Wespo Horizontal Bar-Type Toggle Clamps. Neoprene-capped spindles prevent damage to plastic surfaces, yet securely hold the parts during the drying operations. Wespo toggle clamps are available in more than 80 types and sizes. So, the next time you think clamps, think Wespo!



Simple, low cost "parking brake" for this track-operated frame is provided by a Wespo Push-Pull Clamp equipped with a neoprene-capped spindle. "Brake" is quickly applied or released by a simple flick of the wrist. Wespo Push-Pull Clamps are available in various sizes and holding pressures and are ordinarily used on holding fixtures where push or pull clamping is required.



FREE CLAMP CATALOG!
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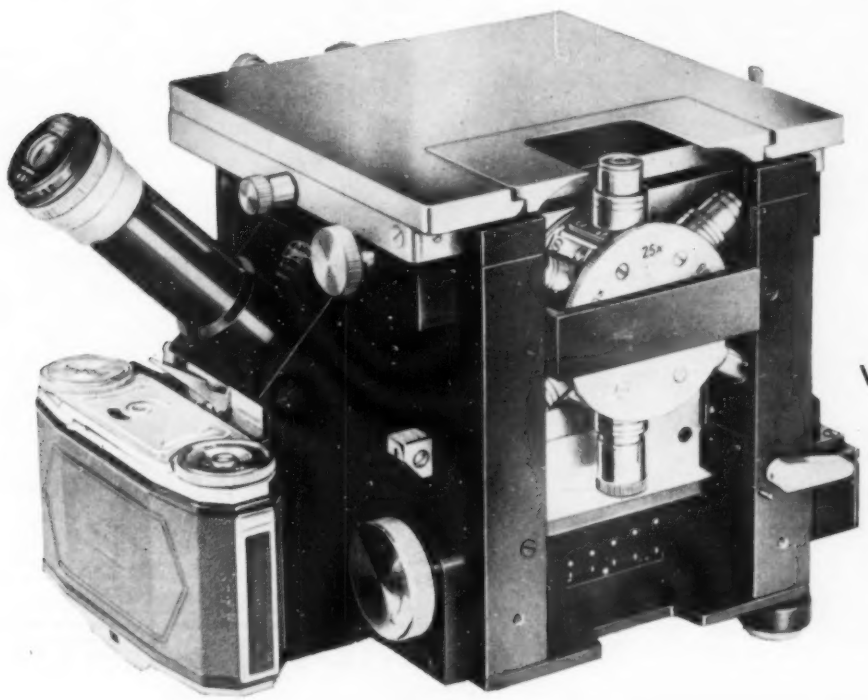

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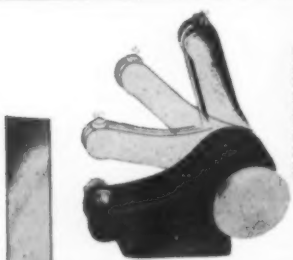

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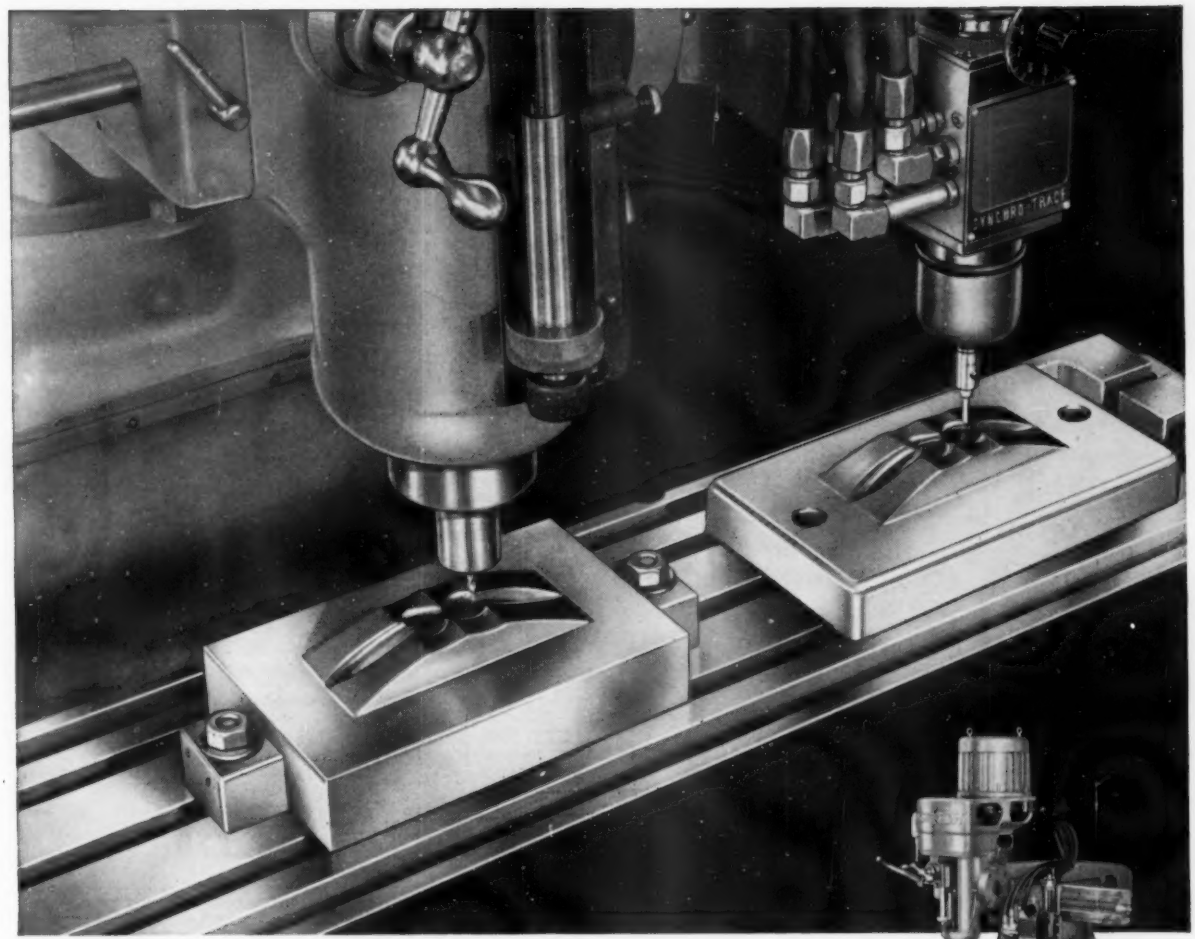

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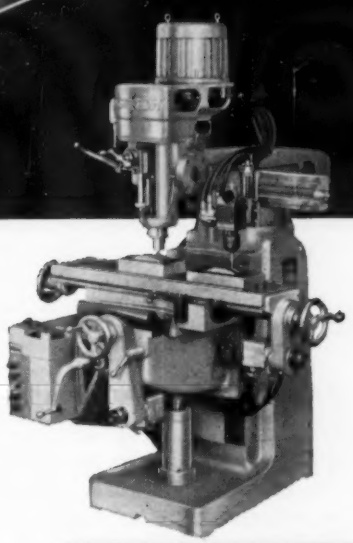

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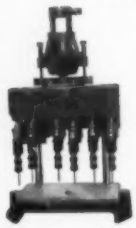

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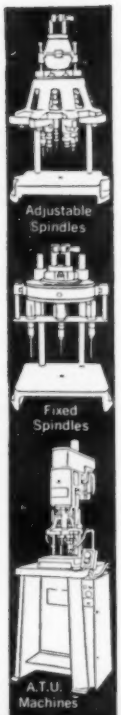

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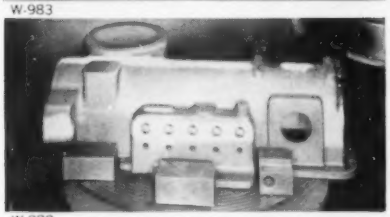

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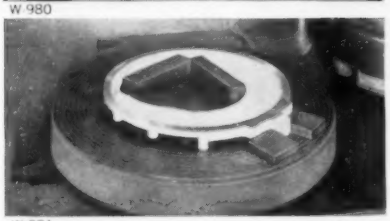

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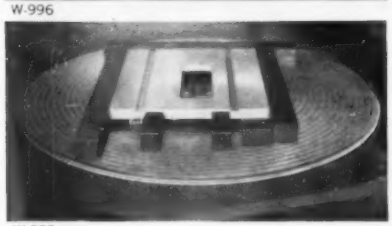

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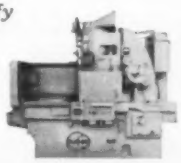

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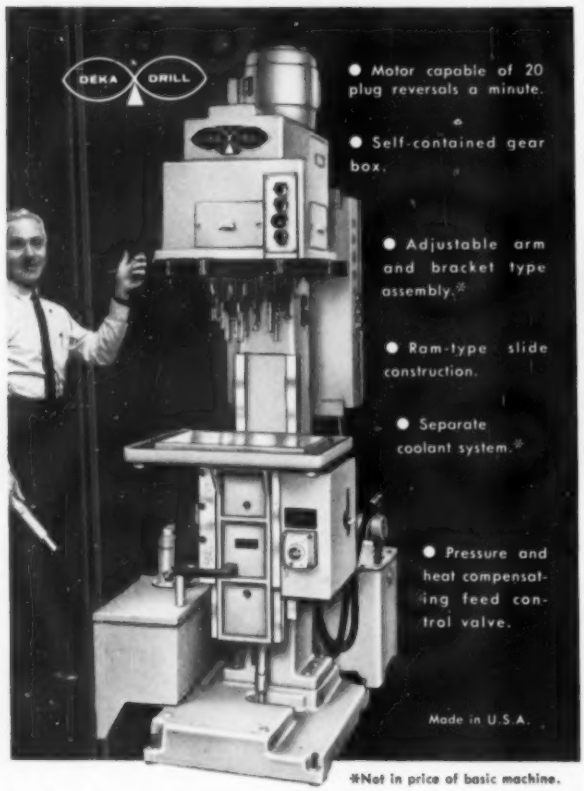
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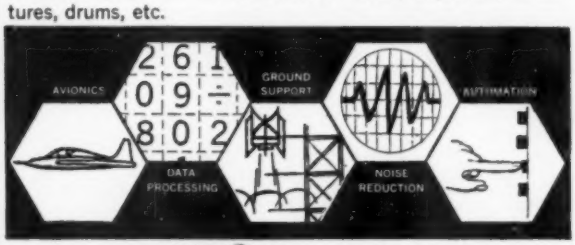

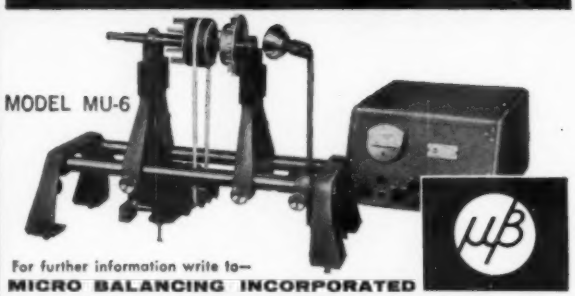

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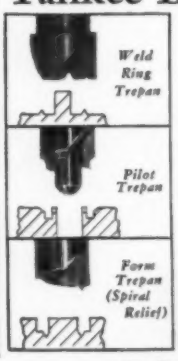

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- Increases tool life on Stainless Steel, Phosphor Bronze, etc.

W&S Trepans are relieved—radially (internal & external) and axially resulting in greater tool life. Available in sizes up to ⅜" diameter with tolerances well within part requirements.

Write today for information on W&S Trepans or any solution to your precision cutting tool problem.

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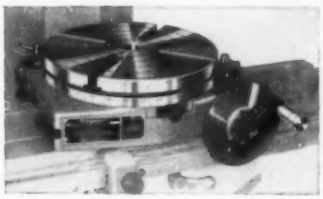
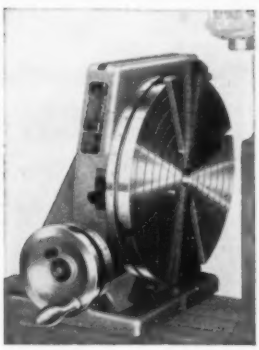
Bridgeport®

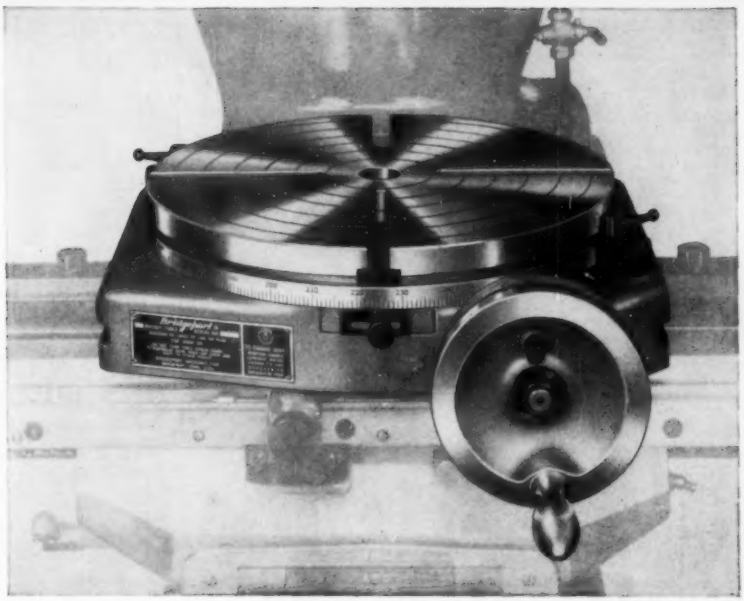
Precision

ROTARY TABLES

MODELS 12", 15" DIAMETER







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WORM and SHAFT	One piece — Hardened and Ground — Alloy Steel.
GEAR	Normalized cast iron fastened to table and machined to extremely close tolerances. Worm can be disengaged to facilitate set up. Adjustment has been provided for the following: worm end play, table radial play, table thrust, backlash of worm.
GRADUATIONS	Table graduated every degree, dial every minute, adjustable zero mark, adjustable dial.
BEARING	Anti-friction, adjustable roller bearing for radial play, adjusting thrust washer for end play.
LUBRICATION	Worm and gear immersed in heavy oil, oil cups for center bearing, table base surface, etc. Unit completely sealed against foreign matter.
LOCKING	Two non-influencing locks are provided.
ACCESSORIES	Tail stocks, centers, 90° angle plate, combination hold downs and handle clamps, indexing attachment and index plates.

Consult us or your nearest dealer for further details

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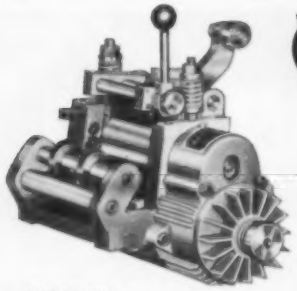
Bridgeport, Connecticut

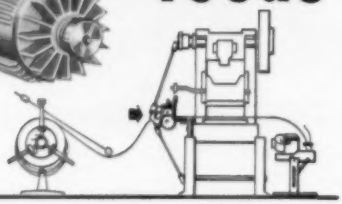
Manufacturers of High Speed Milling Attachments and Turret Milling Machines

FOR HIGH PRODUCTION STAMPING



W roll feeds

SINGLE AND DOUBLE



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MARSHALL'S TIME SAVING COMBINATION
in the most popular sizes of:

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GROUND FLAT STOCK

Over-size specifications:
Under 3/16" thickness, Pre-colored not oversize 3/16" and over, Thickness plus .011" to .013" Width plus .010" to .015".

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DIVISION BRUBAKER TOOL CORPORATION
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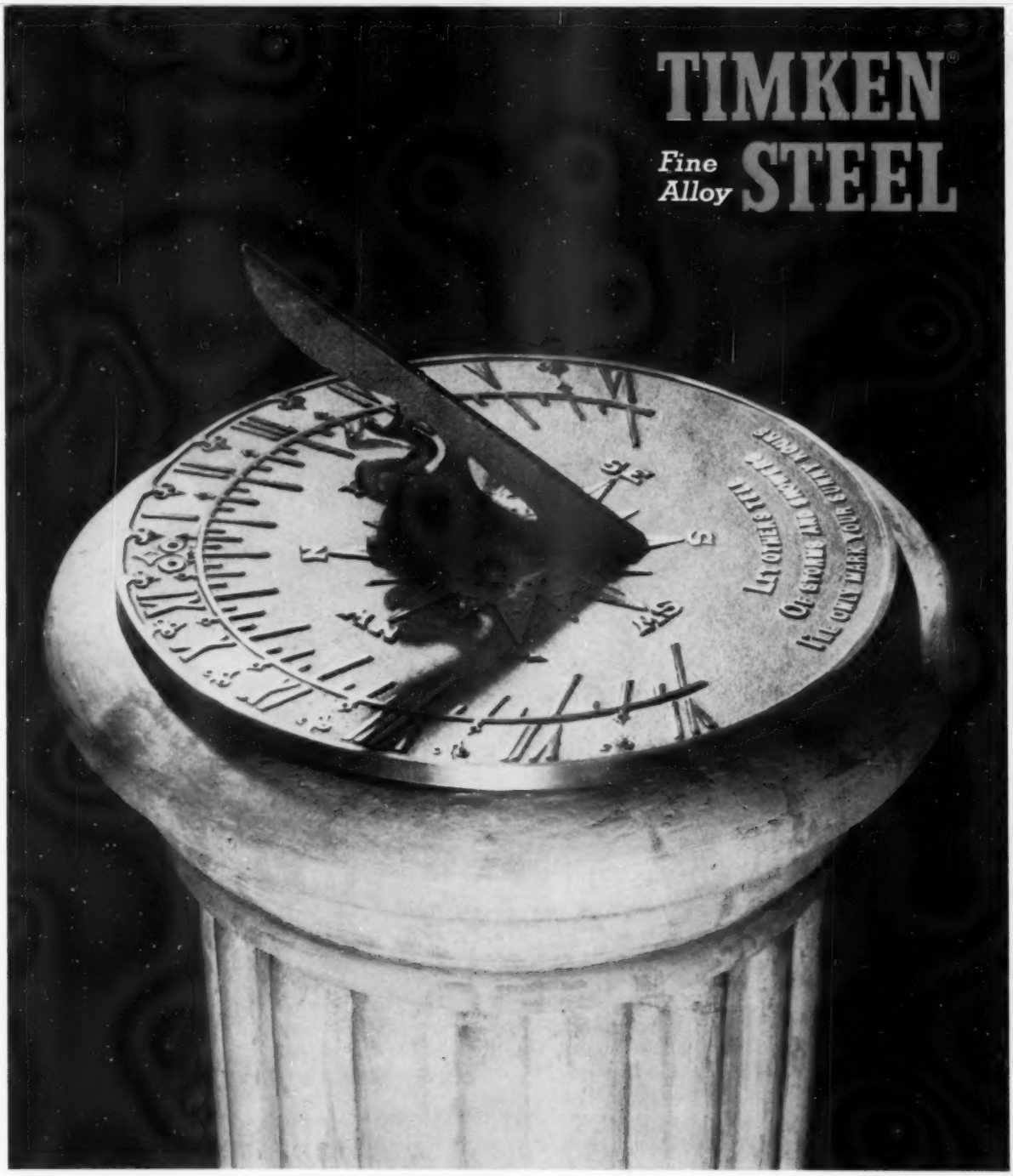

SUN TIME or any time is the time to order your Timken® 52100 steel tubing. It will be shipped within 24 hours of the time we receive your order. We carry 101 sizes in stock—from 1″ to 10½″ O.D., in a wide range of wall thicknesses, to make this speedy service possible for less than mill quantities. And remember, 90% of the structural parts that can be made from seamless tubing can be made from either of the two Timken grades—52100 and 4620. The same service is available on 50 sizes of 4620 tubing. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.*

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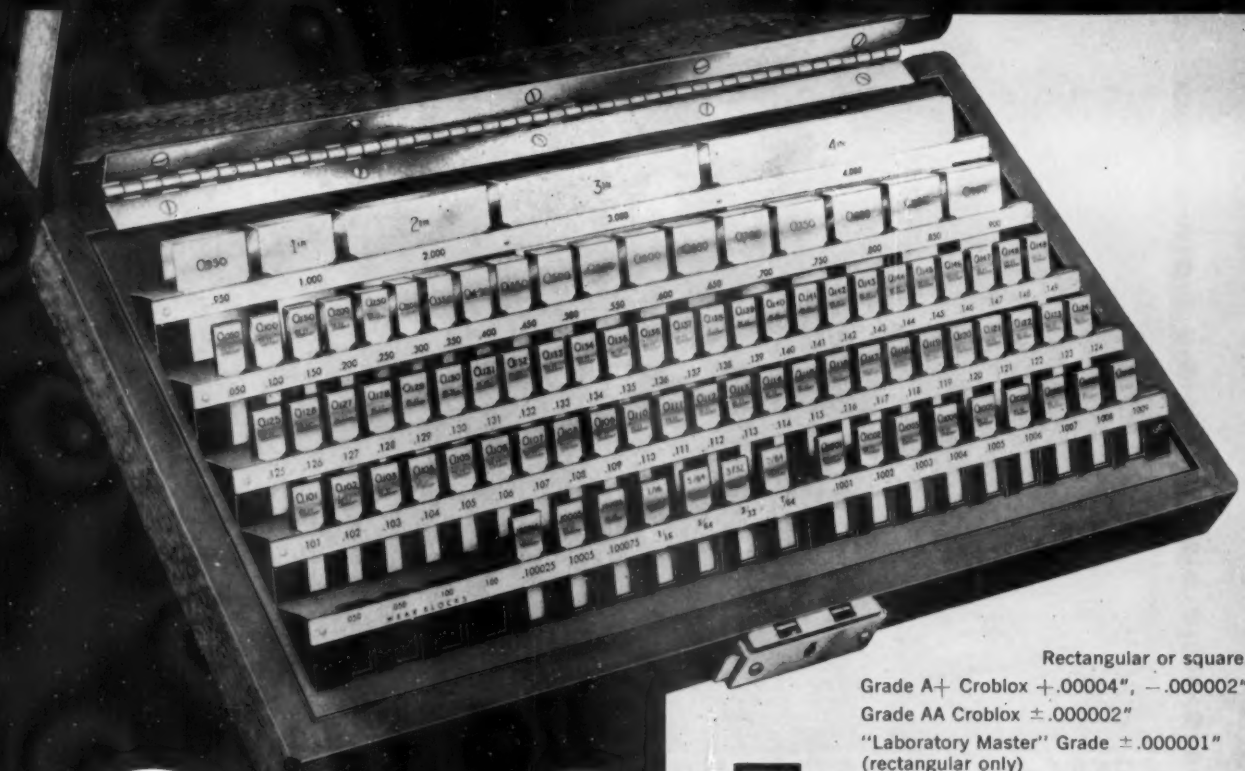

Rectangular or square.
Grade A+ Croblox +.00004", −.000002"
Grade AA Croblox ±.000002"
"Laboratory Master" Grade ±.000001"
(rectangular only)

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Solid Chrome Carbide

are the lowest cost Gage Blocks

—based on the many extra years of service they give.

WEBBER Croblox, made of solid chrome carbide, one of the hardest metallic substances known, have a useful life expectancy up to 70 times that of standard steel blocks.

This fact alone makes Croblox a great money saver for manufacturers of precision products.

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Another saving. Croblox, being 30 times more corrosion resistant than 18-8 stainless steel are not affected by moisture, finger prints, body or airborne acids, all of which can affect the accuracy and wringability of steel blocks.

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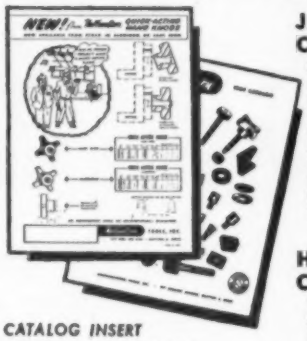

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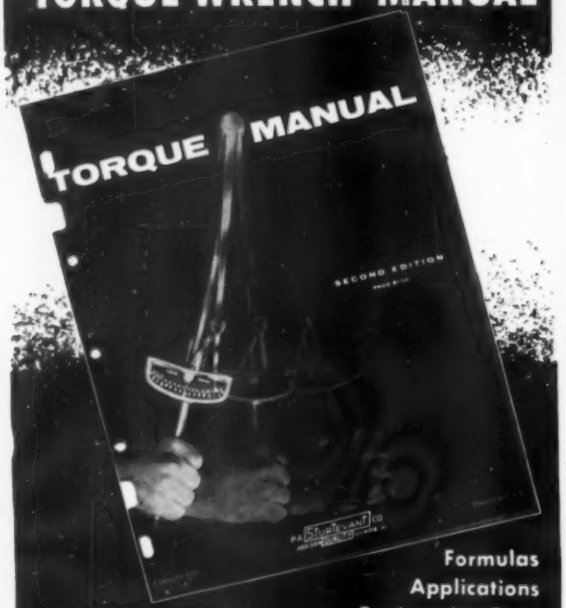
"TORQUE WRENCH" MANUAL



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Formulas
Applications
Engineering Data
Screw Torque Data
Adapter Problems
General Principles

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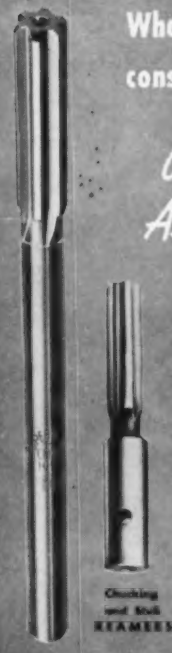

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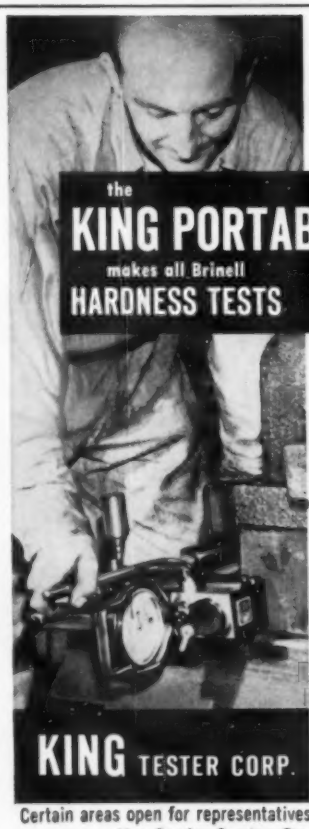

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the KING PORTABLE makes all Brinell HARDNESS TESTS

quickly, accurately, ANYWHERE!

Round, flat or unusual shapes or sizes are no problem to test with the King Portable. Rugged—lightweight, it tests metals from softest leads to toughest alloys having over 700 BHN. And it can be used anywhere, accurately!

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KING TESTER CORP.

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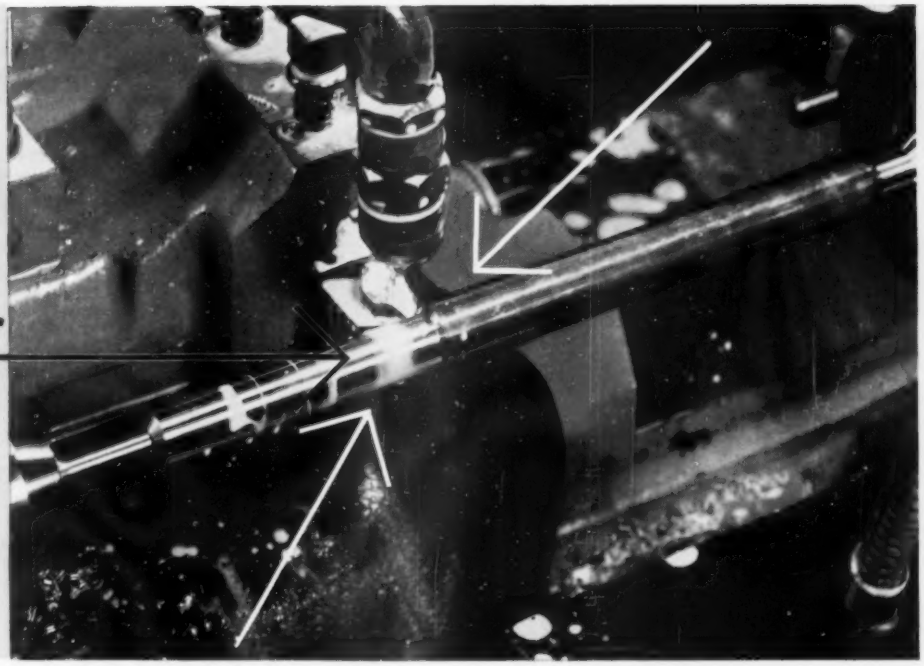
"Action-Center"

THAT COUNTS...



UNIMET U-80 Triangular Throw-aways boost production on Tracer Lathe job!

THESE ARE THE FACTS:

PART	Spindle
MATERIAL	AISI 1141 Steel
MACHINE	Monarch Tracer Lathe
CARBIDE	UNIMET U-80 Positive Rake ▲Throw-away
FEED	16"/min.
RPM	2100
SFM	475
DEPTH OF CUT	.0875" ±.001
LENGTH OF CUT	11"
NUMBER OF CUTS PER CORNER	600
FINISH	120-140 Micro-Inches, R.M.S.

The "action-center" of any metal removing job is the point of contact between cutting tool and work. It is what happens at the "action-center" that determines whether you are producing work fast enough to make your machine tool pay off—fast enough to make your product competitive at the market place.

The statistics at the left show clearly how one Unimet customer got the results he needed. This is a typical instance of better "Action-Center" performance—achieved after one consultation with a Unimet service-engineer. Ask your distributor about Unimet. It can easily lead to improved production results for you.

YOU can improve production . . . USE the 3-step UNIMET plan . . .

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Get your Unimet "Performance Data & Trouble-Shooting File." Free — when requested on your letterhead.

Step Two

Obtain Unimet's 32 page catalog from your distributor or by direct request to Unimet.

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Review your operation with a Unimet Engineer. A free service that can lead to big results.

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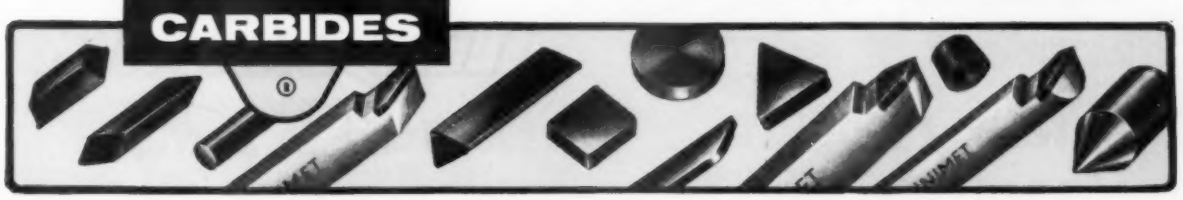
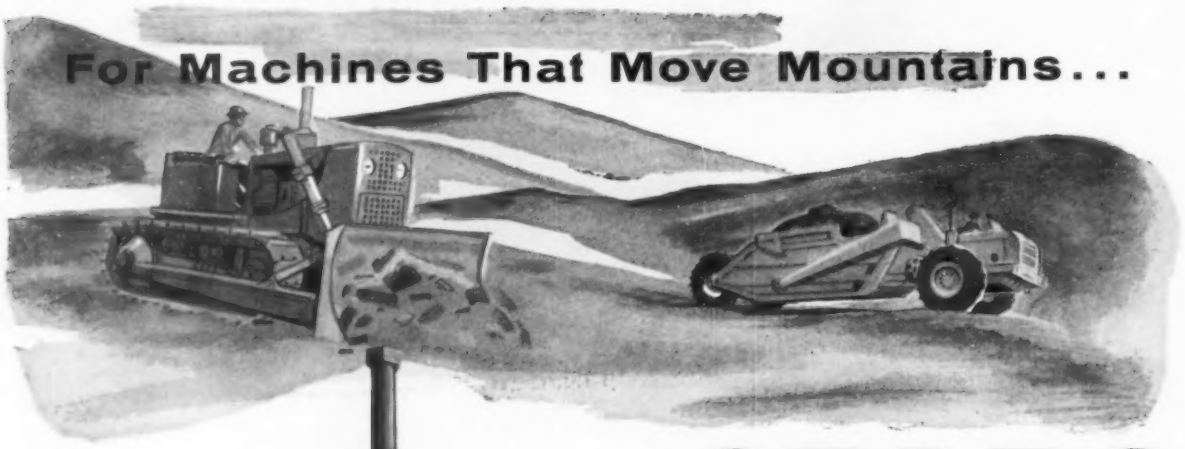
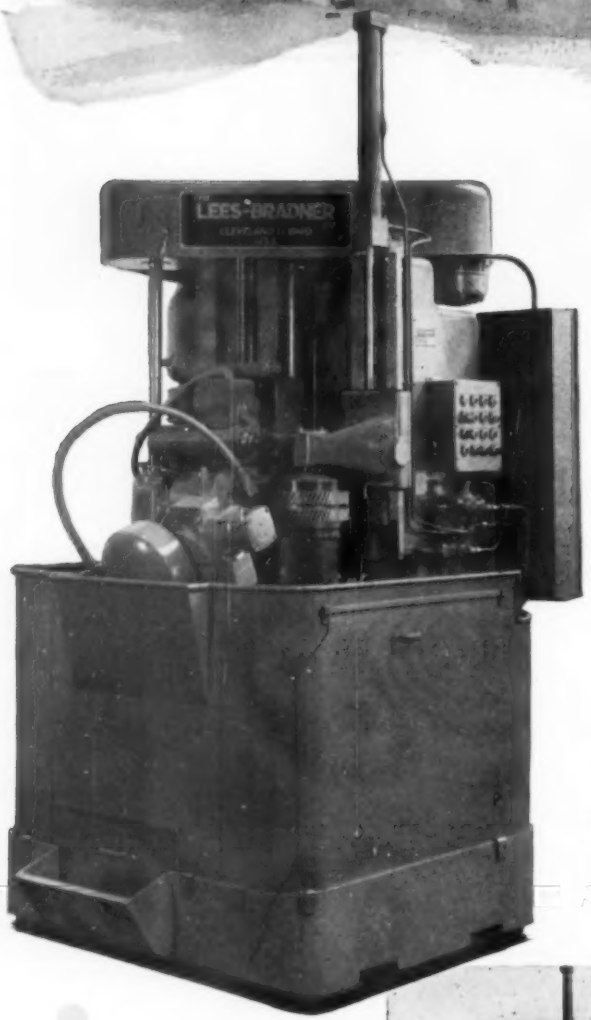


For Machines That Move Mountains...





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from the NEW 12-HD LEES-BRADNER

You asked for it and Lees-Bradner has built it . . . after years of design planning and months of building and testing.

This rugged hobbing machine — known as the 12-HD 12" x 20" — will produce gears up to 8, 9, 10, even 12 inches in diameter at mass production speeds. A revolutionary innovation is the new variable speed A.C. drive, using stock — *not special* — stock A.C. motors!

Now truck, tractor and earthmoving equipment manufacturers can generate heavy-duty gears as efficiently as smaller ones have been made.

Write Lees-Bradner for all the details — or get in touch with our representative in your area.

SPECIFICATIONS

Rated capacity in steel	4 D.P.
Max. diameter capacity (with 5" hob)	12"
Max. helix angle	45°
Taper in work spindle nose	16 B & S
Floor space	60" x 60"

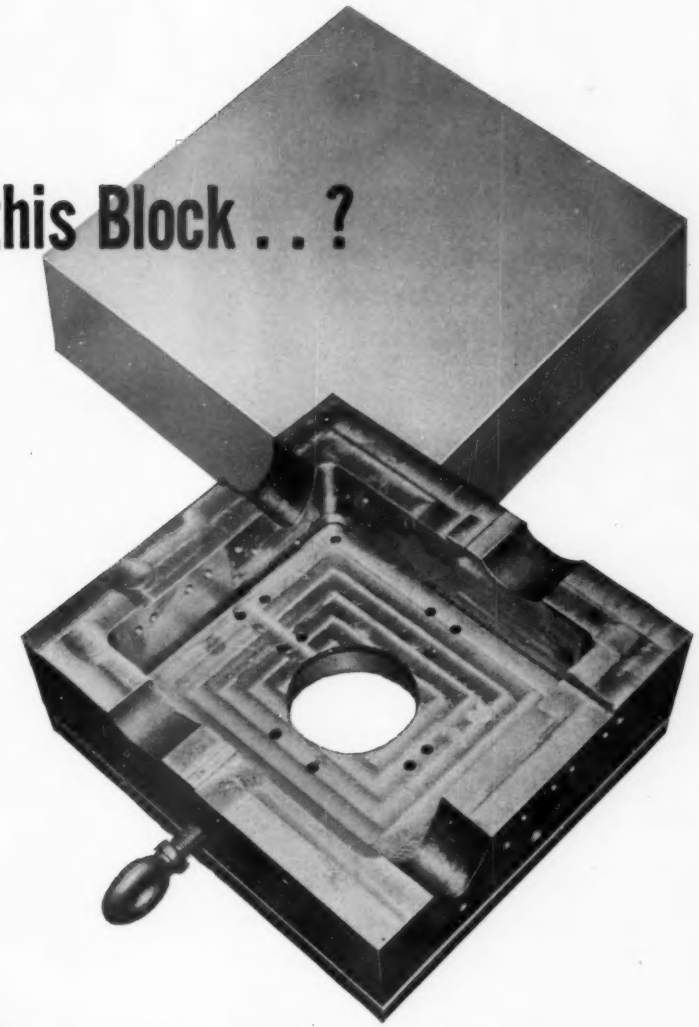
THE NEW 12" x 20" 12-HD
Designed to produce large, heavy-duty gears at high-production speeds.

Can be equipped with lead differential, electric hob shifter and hydraulic controls.

IMPROVING GEARS FOR 50 YEARS

the LEES-BRADNER Company
CLEVELAND 11, OHIO, U.S.A.

Why start with this Block . . ?



When you can use A-L cast-to-shape tool steel

and save $1,250 on the finished job!

Here's how a manufacturer of automobile horns saves $1,250 on this die retainer or holding block by specifying an Allegheny Ludlum Cast-to-Shape tool steel, prehardened to specifications

The block contains 1250 pounds of expensive alloy steel. Also 150 hours of machining time at a cost of $1,000 are needed to fabricate it into a die retainer.

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Allegheny Ludlum Cast-To-Shape tool steel castings are available in a full range of grades. There's one to fit your needs. Write for booklet FC-4. It's free.

The new edition contains 28-pages of technical discussion on A-L's Forging and Casting Division with applications, pattern information, design tips, analyses and heat treating instructions.

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To find out how you can cut costs on complex tools, using F & C products, call your nearest A-L Tool Steel representative or write ***Allegheny Ludlum Steel Corporation, Forging & Casting Division, Ferndale, Detroit 20, Mich. Address Dept. TE-4.***

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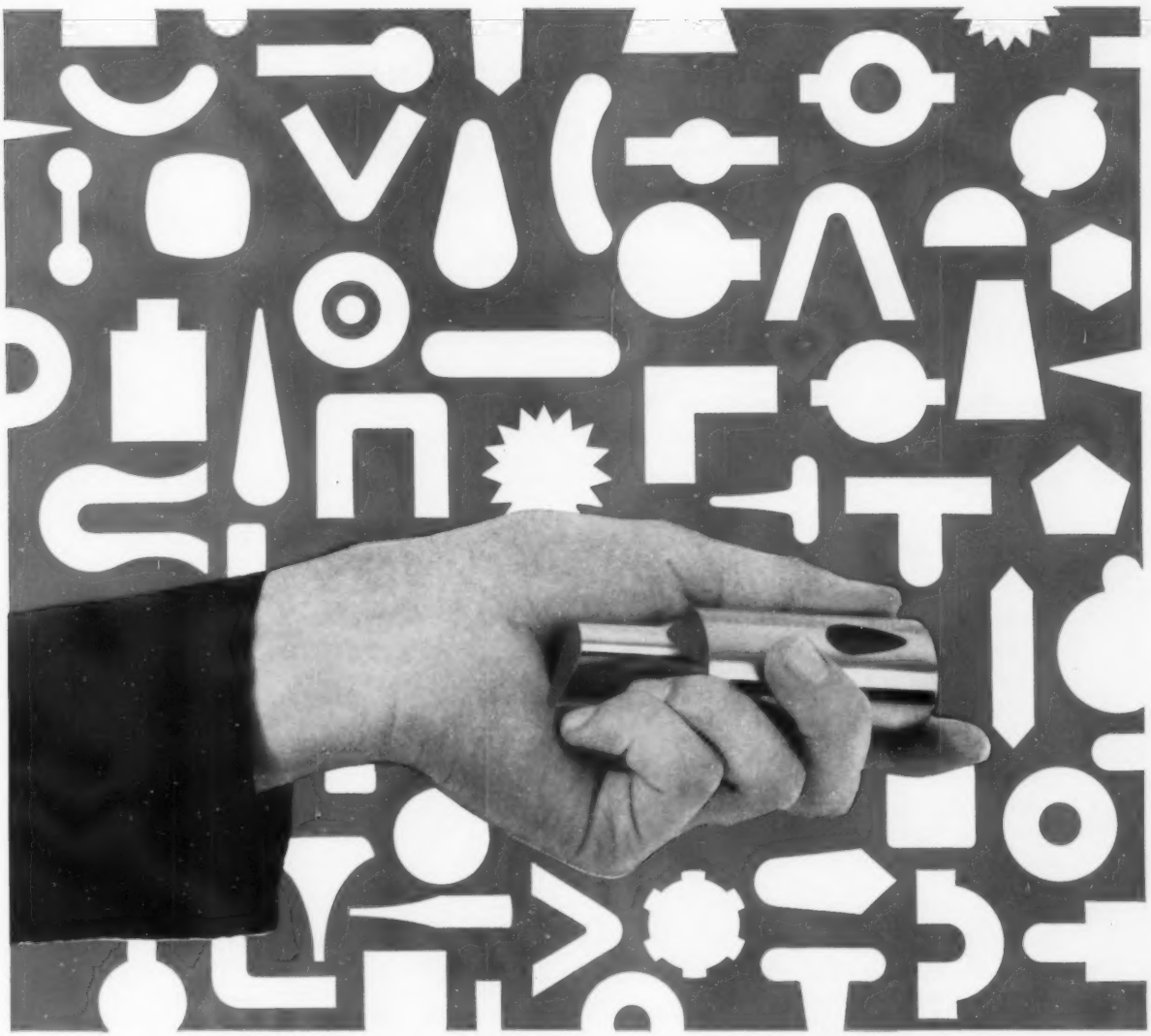

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PROCESS PLANNING

April 18-19, 1961 • Statler Hilton Hotel • Cleveland, Ohio

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Ohio Crankshaft Company
Cleveland, Ohio

John J. Gapstur
Die and Tool Engineer
Quality Gage Company
Cleveland, Ohio

Technical Papers will be presented by the following:

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Sylvania Electric Products, Inc.
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Richard D. Gross
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Philadelphia, Pennsylvania

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SEMINAR OUTLINE

I *Operations Research Applied to Processing Planning*

II *Measuring your Present Manufacturing Efficiency*

III *Economic Considerations for the Establishment of Process Planning Systems*

IV *Process Planning Case Studies*
(Theoretical and Empirical Methods)
- a. Inventory Management
- b. Long Range Planning
- c. Production Scheduling and Control

V *Facilities Planning and Forecasting*

VI *Operations Research as Applied to Tooling*

VII *Replacement Schedules for Tools and Capital Equipment*

VIII *Process Planning Analysis*
- a. Overall Production Control
- b. Make or Buy Decisions

IX *Work Shop—Manufacturing Simulation*

X *Problem Clinic and Open Forum Discussion**

*All speakers will participate by answering questions and discussing problems presented to them.

MEETING TIMES

Grand Ballroom, Statler Hilton Hotel

APRIL 18, 1961

8:30 a.m.-9:45 A.M.—Registration
9:45 a.m.-4:30 P.M.—Presentation of Papers and Case Studies

APRIL 19, 1961

9:00 a.m.-12:00 NOON—Presentation of Papers
1:00 p.m.- 3:00 P.M.—Work Shop

PROCESS PLANNING **5C60**

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*Position*_____

*Company*_____

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. . . fill out the form and send it to Gilbert E. Seeley, Education Director, ASTME Headquarters, 10700 Puritan, Detroit 38, Mich. Registration must be made in advance. Confirmed registrations canceled later than two weeks before the Seminar are subject to a $10 service charge.

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TOOL CRIB SECTION

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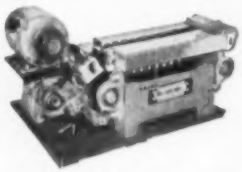

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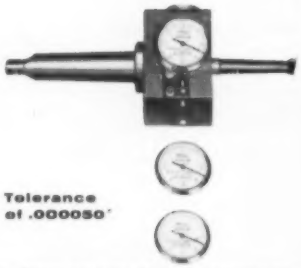

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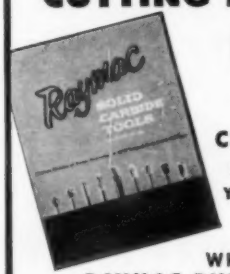

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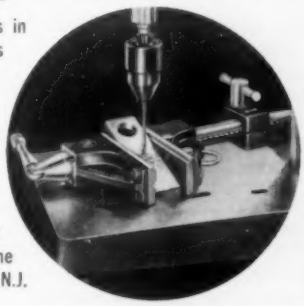

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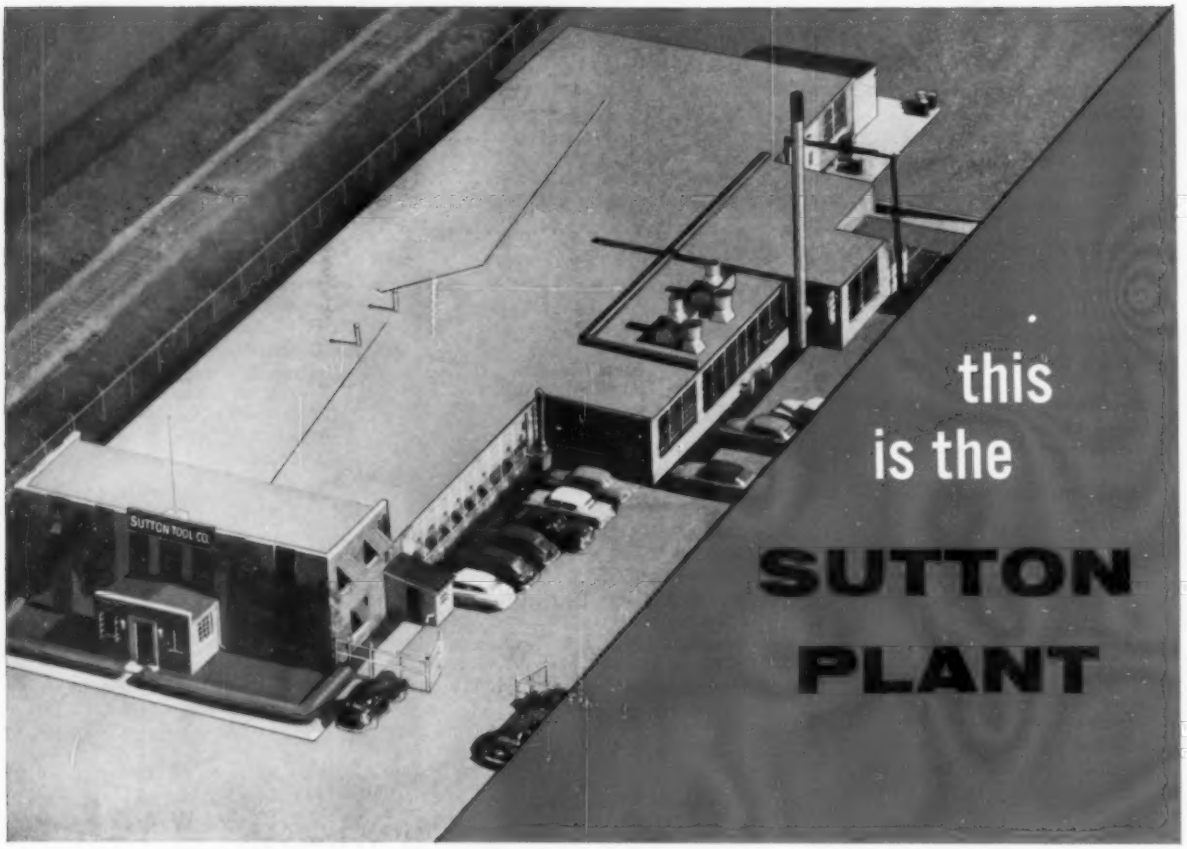

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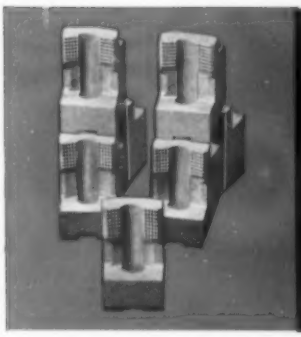

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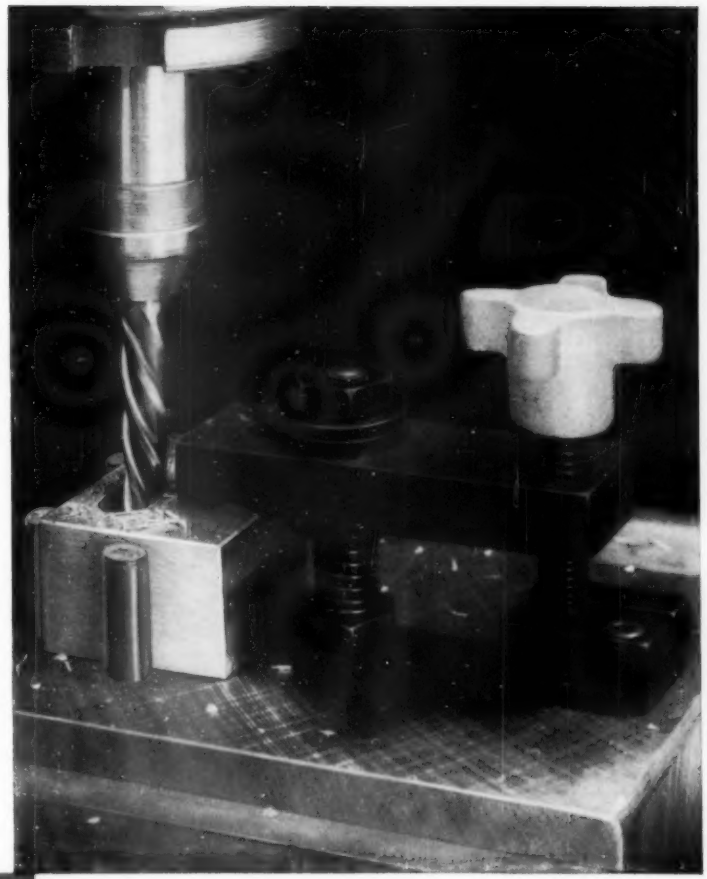

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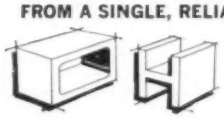

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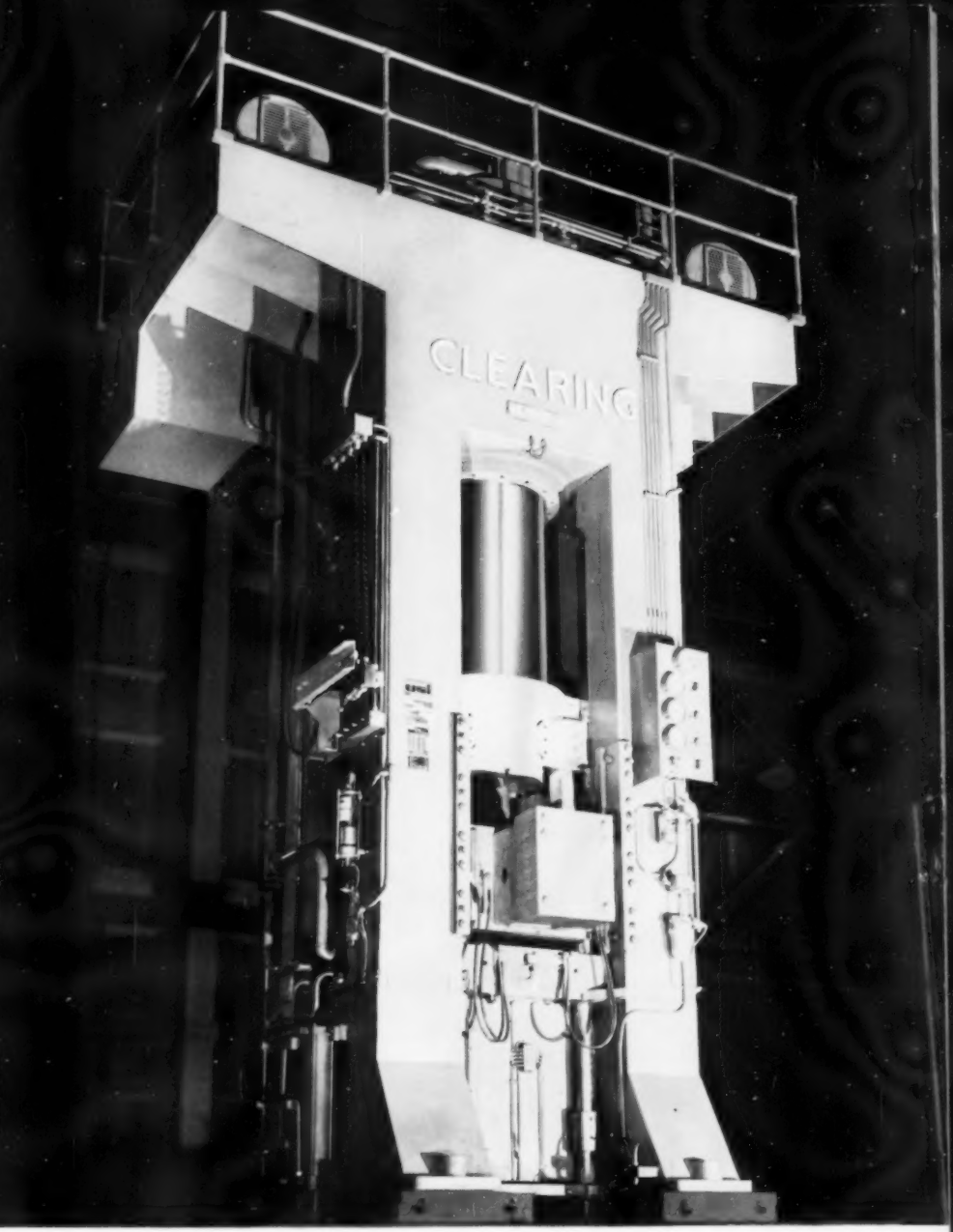

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